MAR 23 1923
Chemical Library

AMERICAN JOURNAL of PHARMACY

SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

PUBLICATION COMMITTEE

Charles H. LaWall, Ph. M. Joseph W. England, Ph. M. J. W. Sturmer, Pharm. D.
John K. Thum, Ph. M. Heber W. Youngken, A.M., M.S., Ph.D. E. Fullerton Cook, Ph. M.
IVOR GRIFFITH, Ph. M., Editor

Vol. 95 MARCH, 1923 No. 3

CONTENTS

Editorial:

The Banquet of the Elements 131

Original Articles:

Another Drop of Blood. By Ivor Griffith, Ph. M., Philadelphia 133

The Evolution of Chemical Terminology. IV. The Therm. By James F. Couch, Washington, D. C. 150

The Iron Content of Lettuce. (Illustrated.) By Aaron Lichtin, Ph. G., Philadelphia 154

Obituary:

Clement Belton Lowe (Portrait). By Dr. Eugene G. Eberle, Philadelphia 159

Abstracted and Reprinted Articles:

The Estimation of Codeine. From *The Analyst* 163

The Teaching of Science. From *Science* 166

Scientific and Technical Abstracts 176

Medical and Pharmaceutical Notes 179

Book Reviews 182

Price $3.00 per Annum in Advance. **Foreign Postage, 25 Cents Extra.**
Single Numbers, 30 Cents. Back Numbers, 50 Cents.

Entered as Second-Class Matter at the Post Office at Philadelphia, Pa., Under the Act of March 3, 1879.

Acceptance for Mailing at Special Rate of Postage Provided for in Section 1103, Act of October 3, 1917, Authorized February 15, 1920.

PUBLISHED MONTHLY BY THE

Philadelphia College of Pharmacy and Science

145 North Tenth Street, Philadelphia

Headquarters for
the ENDOCRINES
and other
ORGANOTHERAPEUTIC
AGENTS.

PHARMACEUTICAL DEPARTMENT OF ARMOUR AND COMPANY

PEPSIN—new process, scale and powder, extra strong, instantly soluble, without odor.

PANCREATIN—full tryptic and amylolytic power, strictly U. S. P.

THYROIDS AND THYROID TABLETS—1/10, ¼, ½, 1, 2 grain. Standardized for iodin content.

ELIXIR OF ENZYMES—digestant and vehicle. Potent and palatable.

BENZOINATED LARD U. S. P.—1, 5, 10 lb. tins. Pure leaf lard for Pharmaceutical purposes.

ESSENCE OF PEPSIN.

ELIXIR OF LACTATED PEPSIN—2 and 5 grains.

CORPUS LUTEUM—Powder and capsules, 2 and 5 grain tablets.

SUPRARENALS—Powder and 2 and 5 grain tablets.

SUPRARENAL CORTEX—Powder and 3 grain tablets.

SUPRARENAL MEDULLA—Powder and 1 grain tablets.

PARATHYROIDS—Powder and 1/20 grain tablets.

PINEAL SUBSTANCE—Powder and 1/10 grain tablets.

AND THE OTHER ENDOCRINES.

If a thing is of animal origin and is ethical Armour and Company can furnish it.

Armour's
LABORATORY
PRODUCTS

New price list just out for Drug Dealers

ARMOUR AND COMPANY
CHICAGO

6754

THE AMERICAN
JOURNAL OF PHARMACY

VOL. 95. MARCH, 1923 NO. 3.

EDITORIAL

THE BANQUET OF THE ELEMENTS.

Moseley, the brilliant young English physicist whose fruitful life was lost in England's cause during the World War, passed away in the hey-day of his scientific glory and with him into the everlasting silence went many, many potential secrets, which will remain untold until another kindred mind will sense again the things that Moseley sensed.

For Moseley was a man who saw tomorrow. Many years before him, the Russian, Mendeléeff, another sapling mind, had also looked ahead. He, like Moseley, had seen as others could not and with the unselfishness that marks the true scientist, both had shared with all the world their precious information.

And long before them, dabblers in alchemy, searching for the same intelligence, had come to the fanciful conclusion that all matter was built of five elemental things. Four they named—air, earth, fire and water; the fifth, which they knew not, they promptly called the *quintessence,* for lack of a better name.

Then through the advancing centuries men had continuously wondered and wondered as to the real number of elements that figured in the constitution of all material things.

But it remained for Moseley to visualize the actualities and to call to assembled convention these silent builders of the universe—the elements.

Helped along by the roentgen-ray spectroscope, his genius called them all to task and made them all respond, if not in person, at least by proxy. The final count showed that they numbered ninety-two.

"Ninety-two," said Moseley, "ninety-two, not one less, nor one more, constitute the complete group of the earth's elemental builders." He grouped these elements around the table (the periodic table) selecting for each a worthy seat, according to its atomic weight and certain other properties.

But six were missing from their places.

Empty chairs for 43 and 61, for 72 and 75, for 85 and 87. Said Moseley: "This will never do, ninety-two places have I set and my ninety-two guests must come. Science will search, and search, and search until the last, lone element comes on to fill the only empty seat."

So science went out to search. Moseley passed on to the Infinite, but his comrades still carried on. And not a word came to count the progress of the search for the vagrant guests until the other day, when two Danish professors, between them, dragged to the waiting table a guest, called Hafnium, the missing element of seat number 72. This element possesses all the earmarks which Moseley had announced for one of the absent six. Science seems satisfied that this is not a case of mistaken identity and the new guest today reverently sits with his fellows eagerly awaiting the coming home of the tardy five.

Hafnium was in hiding in Norway and Drs. Coster and Hevesy, who used the X-Ray spectroscope to rout it out, decided that the name of the element should be after Hafnia, the Danish for Copenhagen, where their great work was done.

The new element has not yet been isolated except in combination as an oxide. It appears to have an atomic weight of about 180 and is chemically allied both to the rare earths of the thorium group, and to titanium and zirconium. Oxides of these elements are used in gas mantles and it is thought that the oxide of the new element may be so used.

"One by one," said Moseley, "until the total comes to ninety-two, not one less, not one more."

I. G.

ORIGINAL ARTICLES

ANOTHER DROP OF BLOOD.

By Ivor Griffith, P. D., Ph. M., Philadelphia.

(One of a Series of Popular Lectures Given at the Philadelphia College of Pharmacy and Science.)

On a former occasion it was this speaker's privilege to dwell at some length upon a kindred subject, and to devote at that time most of his attention to the physical form elements of this important body tissue. So that a semblance of continuity may be maintained, we shall occasionally bring into this evening's presentation fragments of the former lecture. We prefer, however, in the main to focus our attention upon the less known characteristics of blood, upon the hypotheses advanced by scientists to explain certain blood functions, and upon the newer understandings of blood activities, not confining our discourse to any particular arrangement or system.

We ask you, of course, to consider the blood of which we speak as human blood, unless otherwise stated. Like every good preacher we faithfully expect to wander from our text with regularity, and carry you with us to fields quite remote from these infenced pastures. We speak of a drop of blood in the title. It is of blood, regardless of volume, that we speak throughout the lecture.

Blood is a tissue, an organ of the body, quite as distinct as the liver, or the heart, or a muscle. It is a wandering tissue so important to the economy that it can never stay long in one place, but must unceasingly travel through its sinewy canals to perform its endless obligations. It is the most vital tissue in the body.

Indeed the whole story of life lies hidden in its actions. Seek out one little cell from the myriads that silently flow through vein and artery, and in its microcosmic being is locked securely the wonderful secret of life. The mystery of Life lies hidden in action—in activity, and despite man's closest scrutiny, hidden it shall remain for many centuries to come.

Not physics, chemistry, anatomy or histology has brought us much closer home to a real understanding of Life. For when we have unearthed all basic rules and laws of physics, when the last analysis of the protoplasmic protein shall have been writ in final record, and when

with the aid of microscope and microtome we shall have carried our anatomical quest to its very end, to the simple fundamental cell, we are still grappling with a relentless mystery. For even this simple cell, a formless fragment of protoplasm, has all the earmarks of a living unit, all the essential processes of a separate vital entity. It consumes and requires food, it develops with its environment, it reproduces its own kind, it moves with predetermined direction, and strangest of all, it shows decided leanings to real sense.

Such a structureless little cell is the Vampyrell, a variety of amœba much like the white blood cell in its behavior, and labelled by the scientists the Vampyrella Spirogyra. This structureless little organism is a picky little creature, decidedly picky. It will partake only of one form of food, namely, a minute variety of algæ called the spirogyra. It can be observed on the hunt for food, stretching in all directions and creeping cautiously along in pseudopodic motion until at last it meets its quarry, when it will grasp the algæ, fix itself to the latter's overcoat of cellulose and, like a blood-sucking ferret, draw out the contents of the algæl cell. Then it disengages itself and contendedly pseudopodies on to meet its next food morsel.

Now this simple little cell will never take up with any other algæ and experimenters who have purposely placed before it other algæ, almost identical in form, have seen them always rejected. The behavior of these little unicellular simple cells in their search for food and their methods of obtaining it are so marvelous that one can hardly avoid the understanding that their acts are those of intelligent, conscious beings.

And what is true of the Vampyrell is also true of every blood cell in our bodies. Each single one of the blood cells which we see floating in the microscopic field is a micro-cosm, a world in itself, obedient to the laws of its own kind, and only functioning while Life stays home among its molecules.

But human search for Life's hiding place will continue into the long years. Science will always be asking questions, and continue to progress with its marvelous answers. Indeed not even the narrow confines of human intellect shall hinder its onward march. For human intellect itself marches onward with the years.

Out where eternity starts time was when the only life that existed upon our planet was in the infusoria that floated in the brackish shallow waters of the warm primeval seas, and we are the evolutionary

products of these forerunners of all living things. The race of man will some day be as far removed from us as we are far re-removed from these jellied infusoria. And who today stands bold enough to even dream of man's intellectual capacities at this stage of his evolution?

But there are those who say that even then shall the mystery of Life be sealed from man's understanding. And there are those who say that we are on the edge of tremendous discoveries. The evolutionists, the supporters of mechanistic theories of life, the fundamentalists, all seem to feel their ground secure, and even go so far as to question room for religion in their queer world of science.

But in these hectic days of argument when religion and science seem incompatible and inimical, and when theories of evolution are bandied about in puny human quarrels, it is pleasant to hear a philosopher come out of the wilderness to say, as did MacDougal recently, that evolution indeed does not destroy, but that it rather justifies, religion.

And in this connection the speaker cannot refrain from mentioning again an episode of his early Sunday school days, when his old physician teacher said that he had always been greatly fearsome of the day when some blundering, scientific idiot would come upon the secret of Life, and so bring on the whole human race the mighty wrath of a Creator whose most precious riddle had been solved by a mere creation called man.

There are those who seek to explain the processes of all vital tissues on purely mechanical lines. To these people every movement of our bodies, every concept of our minds, every leaning of our desires, our inspirations, our hatreds, our loves, our longings, our every phase of action, is inevitably governed by the ordinary laws of physics and chemistry. These are the people who predict the coming of a day when science will give a chemical formula for Life.

And science indeed is coming peculiarly close to doing this. As Vernon Kellog has recently stated: "The chemists and physicists keep pushing in on the field of the biologist; they keep claiming more and more share in the telling of what life really is, not what its joys or goal are, but just how being alive is different from not being alive."

He concludes that life is a series of balanced chemical processes, and that when this balance is disturbed by a change in environment

one process goes faster than another, and then the living creature grows or decays, thrives or declines, goes on living or dies. It is all a matter of chemistry.

This is the kind of thing that keeps coming from the school of the mechanist biologists, the school that clings to the "mechanistic conception of life." Naturally, as life at its simplest is pretty complex, these mechanist biologists have not got far yet in explaining the life and behavior of human beings on a physics-and-chemistry basis, except, perhaps, they may claim to explain in some measure the fundamental factors in one's being alive at all.

We wonder, moreover, how anyone with this mechanical conception of life can explain the following fact: How can a single spermatozoon with its cell so minute that fifty millions can move freely in a drop of liquid, permit the passage of all the physical and mental peculiarities from father to son, or, by the aid of this single little cell, even skip the son and reappear clearly in the grandson?

Can laws of mechanics explain this? This remarkable potentiality in a single cell that can direct forms of motion and modes of development even unto the third and fourth generations? Yes and even transmit mental and spiritual qualities? Here indeed physics, chemistry, anatomy and histology all turn from the light and point their hopeless fingers into the night. We agree with Plato that there are many, many things too close, too intimate, for man ever to know and understand. And so we again say that the story of another drop of blood conceals in its words the story of Life.

As you sit on these benches tonight and sense the throbbing of this vital fluid through its narrow channels in our bodies, do you wonder what power or powers is responsible for its management? Do you listen to the regularity of the heart beat and marvel at the relentlessness of the procedure? And great indeed can be your wonderment, for pressed into every moment of your existence is a multitude of marvels. There is traversing now through the network of routes in your kingdoms, hosts of mighty warriors fighting every minute of their existence so that you can carry on. The precious fluid which we grossly call blood is this wandering military tissue so important to your kingdom that it can never stay long in one place, but must wander on and on, ever working for your welfare and ever fighting to insure your safety.

There are little skirmishes going on unheeded, great duties being attended to without ostentation, huge tissue building operations under way, as you are now silently listening to this discourse. One can in a sense, compare the individual with this great old earth that unconcernedly swims about in its orbit, while in its system are millions of mortals engaged in their various capacities. Nations are embattled and men are murdered by their brothers; the farmer ploughs his fields, the birdman scouts the skies, and the poet writes his sonnets, and through it all the earth still keeps its orbit, the seasons still return in sequence, the day still entertains the sun and night is bright with stars.

But the simile falls far short for even though human life shall leave this planet and man no longer inhabit the earth, the orbit still remains, the seasons still come and go, and earth still serenely exists quite independent of human existence. But not so with the kingdom of man, for the perpetuity and sanctity of his earth depends on the perpetuity and sanctity of its cellular inhabitants, and when they collectively die man's season is over. When Life, the synchronizer of the elements, leaves the blood cell and the tissue cell, man soon begins to yield his substance to the forces of decay and the magnificent throbbing institution where Life once held court soon crumbles to a mere handful of inorganic dust. So no matter where our analysis of the drop of blood shall take us, we find Life intimately concerned in its management.

In our previous lecture we pictured blood as the military establishment of the Kingdom of Animal, a military establishment so marvelously conceived that it is perfect in every detail as long as health prevails. In the heart is its concentration camp, and it is from this central establishment that the blood cells are sent swarming upon their way to attend to their diversified duties, and as the cells traverse through the labyrinths of channels and highways sealed directions come from Headquarters located somewhere in the brain. Sealed messages we say, for no one has been able to definitely tell us the nature of the silent impulses that day in day out, through consciousness and unconsciousness, regulate the rhythmic coursing, the everlasting parading, of the vital fluid to every corner of the animal empire.

Directing this ceaseless march with unfailing precision is the General whom we call Life, and under his command the army is virile and strong, and the maintenance of its fighting and its peace-

time workers goes on in silent continuity. The restlessness of this huge military organization keeps busy a vastly greater force of auxiliary workers whose business it is to supply the army with its forage, to care for its ammunition, to provide a sanitary environment, to insure the perpetuation of its numbers, to heal its wounded, to bring in its dead, and to look after divers other phases of its activities.

So that the picture may return to us with some realism, it may not be amiss to recount the story of a battle in which these fighting forces of the body are engaged. Indeed there are skirmishes constantly going on in our bodies, where the body pays the sacrifice which must always follow victory, namely, the loss of myriads of its white cell warriors.

The little pimple, the boil, the carbuncle, are all local battles of white cell and germ. But these are only insignificant battles where only a small fraction of the blood's forces are called into action. The innumerable reserves are still untouched, for elsewhere in the body are myriads of potential warriors only waiting their chances to enter the fray, but the Commander-in-Chief and his Staff know that this is not the time for pressing the Old Guard into service. Theirs is another day and another fight.

The Battle of the Boil is but a Gallipoli, where the enemy lands and never gains headway, but is promptly forced back from the mainland into the seas of destruction.

A more serious combat, a truly great war comes, however, when the enemy strikes at the heart of the country. Consider Typhoid Fever. A harmless looking rod-shaped germ, invisible, of course, to the naked eye, finds its way, along with myriads of its kind, into the waters of a roadside fountain. A Thirsty Vacationist passing by, disregards the precepts of the sanitarians and indulges in a drink of country water "right from the spring." The little babbling brook that carries the cool water from the breast of the mountains down to the roadside fountain, runs caroming through a valley dotted with farmhouses, and murky trenches that carry the wastage and sewage of the community seep their waters into the singing brook. The brook becomes contaminated from the excretions of a typhoid patient in the farmhouse on the hill, and the deadly germs are carried into the drinking cup of the dusty traveler.

Some folks believe that the prerequisite to typhoid infection is indulgence in the waters of any old country well, and still others

know that in every "old oaken bucket" lurk myriads of these murderous microbes. But typhoid comes only from typhoid, and the well or bucket must be inoculated or contaminated with these specific germs before they become a menace to health. And again ten persons may drink of the same typhoid water and only five contract the disease. But then "that is another story." Suffice it to state that stale or stagnant water in which there sports no living typhoid germ cannot produce typhoid fever any more than a guinea pig can wag its tail.

But to return to our afflicted vacationist. The germ of typhoid which bacteriologists call Bacillus Typhosus actually slides down his gastronomic chute and through the stomach into the intestines, thence into the lymphatics of the intestine and mesenteric glands into the thoracic duct, and then into the blood stream. From there it is distributed into the organs and tissues, but like all germs it finds its particular pet locality and there it destroys its surroundings in order to establish its home. And the organism suffers accordingly. The typhoid germ particularly likes the spleen and the bone marrow, and here is where it makes its fight for territory. Here also is the reason why the body so often succumbs so readily to virulent typhoid.

When the typhoid invasion strikes, it strikes for Headquarters—it makes a bid for Paris. In the Kingdom of Animal the spleen and the bone marrow are the main preparing camps where the recruit blood cell armies assemble and whence they are diverted to the main concentration camp in the heart. So that the typhoid invaders generally make for the most important centre of blood activity. The battle is nevertheless waged with intensity and fierceness. The paucity of doughboys is balanced by the increased activity of other departments of the blood's fighting army. The white cells, the so-called infantry, are not nearly so numerous as in many other blood infections, but what they lack in numbers they greatly compensate for in valor and sturdiness.

The germs would indeed find victory easy were it not for the marvelous emergency defenses which the frantic kingdom provides. The strategy employed by the blood forces is unique and subtle, and the unwary germ, too eager in its quest for spoils of battle, overlooks the traps prepared to capture it. Chemical warfare here reaches the heights of perfection. From its entrenchments in the spleen and marrow the army of the germs streams out its poisoned

darts and the blood cells in turn come back with similar weapons. Agglutins that corner the germ divisions and render them immobile and inactive, lysins that really dissolve and destroy the typhoid warriors, antitoxins that penetrate the germ wall and neutralize the internal toxins of the evil germs, and many other potent instruments of war are used by the blood cells to paralyze the invaders of their precious homeland. And the battle wages long and fiercely.

Here not one little external promontory of the body is in danger, but the very existence of the Kingdom, and the General whom we call Life knows this full well as he commands with cunning bravery the onslaught of his well-directed troops. The Commander-in-Chief may be the Napoleon who sits on the heights watching the progress of the Waterloo that long continues to be wavering, uncertain, hesitating and menacing to both armies; the Napoleon who sends the losing army of France pell-mell into the Hell of Ohain; the Napoleon who, with victory close to his grasp, sees it fade away with Blucher's coming, and the crumbling of his trump Imperial Guard. And if the General whom we call Life, in the battle against the typhoid armies is a Napoleon—the sequel is the End of the Kingdom. The typhoid army's victory is the death of the victim, the complete end of our friend, the vacationist.

If we liken the Commander-in-Chief to the English Wellington, who sturdily fights to the last ditch, who, when the onslaught is most vicious, calls to his myriad cells—"Up, Guards, and at them"—we know then that victory comes in its own sweet time and that even though the innermost defenses of the kingdom have been menaced by the typhoid army, the kingdom still exists and that its end has not come. Our vacationist convalesces, lives and will never again fear typhoid.

And so we see that attacking disease germs and conquering them by brute cannibal force is not the only mode of battle indulged in by the warriors of the blood stream. Indeed not, for the close observer of the body's military manœuvers at once finds methods of warfare ever so subtle and yet powerful, ever so delicate and yet ferocious. Blood cells do not always dispose of invading germs by the simple expedient of eating them up. They fit their weapons, their tactics and their numbers exactly according to the type of enemy they are forced to combat. The typhoid germ, a vicious scoundrel that wages war without a single scruple, does not secrete an active

poison while alive and motile, but disgorges itself of the toxin when dead. So the cell fights it with certain stupefying and agglutinating devices that minimize its reproducing possibilities and neutralize the poison released when the dead germ breaks down. Diphtheria germs, on the other hand, make their landing on the windpipe, find there a happy place to raise their children, and oblivious of the host's concern in the matter, proceed therewith to establish their permanent home. The colony grows and diphtheria germs are not particularly keen on sanitation and sewage disposal methods. So their excretions, which we call toxin, are promptly emptied into the flowing blood stream. The equanimity of the system is thus completely upset; the toxins proceed to do their deadly work, and the body works hard to combat them. Antitoxins are developed by the fighting forces of the blood, but unless Blucher comes in the form of an artificial antitoxin the germ generally comes out victorious. However, by manufacturing special anti-poisons the blood cell does its very best to fight the dread disease and uses every weapon within its power to keep the organism intact and Life still in the saddle. Only the unusual fierceness and toxicity of the diphtheria poison often makes the battle too one-sided unless the ally—horse-serum anti-toxin—is called at once to help.

And there is no better example of scientific attainment in medicine than the treatment of diphtheria with Behring's anti-toxin. But even in this enlightened day there are quacks who would belittle its value, and the same quacks tell us now that the day of genesis is at hand in the world of medicine. This is the cry of the disciples of the man of the West who measures human illnesses by electrons and cures them by vibrations. This new school of oscillopractics and vibratorians (and this is not the first school of sharks within a fisherman's ken), tells us that blood possesses certain vibratory rates which are normal for healthy blood, but which oscillate oddly for every known illness. A drop of dried blood submitted on a piece of blotting paper to one of these intellectuals is sufficient material for a vibratory analysis that will accurately determine whether the owner of the blood has cancer or diabetes, or an ingrown toe-nail. Yes, and they venture even to tell the sex and religion of the bled.

The other day a doctor bearing the fitting name of Thomas submitted to one of these super-doctors, a specimen of dried pig's blood bearing the assumed name of John Hogg (enclosing also the sum of $10, a very essential prerequisite to an accurate test), and back came

the diagnosis to the effect that Mr. Hogg had a vibratory rate corresponding on the scale of diseases to an incipient locomotor ataxia, which may account for the restlessness of a certain brand of sausage with which we were recently served.

We hear on many sides of the ignorance, superstition and standpattism that prevail in medical practice today. Lay persons and preachers bewail the intolerance of the fraternity of physicians who steadfastly refuse to listen to newer developments such as this electronic concept just referred to. But we can rest assured that medicine will not be intolerant to anything that will be of real worth. Medicine has to be wary. Doctors have been so often fooled with fads and fripperies that they have long since learned the lesson of the testing value of Time. The galaxy of headstones in the graveyard of therapeutic fads attest to the truth of this statement. When any new development of medicine appears on the horizon the eyes of the whole profession are turned towards it, and if in their opinion it has honest worth, they not only welcome it, they usually monopolize it, and even claim it as their very own.

Those of you who listen and are disturbed by the speaker's ridicule of these electronic concepts, need not be overly exercised, our ridicule is not meant for the theory but for the quacks and charlatans who pose as servants of the invisible empire, who have delved into the electronic mysteries of the universe so deeply that the most profound scientist cannot follow their thought, and who by their tricks and cheateries mislead and endanger the lives of the foolish victims and deluded believers who lend a willing ear to their absurdities.

We do not deny the electronic nature of the human body, for that is to deny the electronic nature of everything. Human blood, indeed, when viewed through the spectroscope, reflects its light vibrations so that when there is methemoglobin present we find certain absorption bands, and when oxyhemoglobin is present these bands occupy different places in the spectrum. But when we carry this far beyond, and say that if these light vibrations will show different bands for different chemical constituents, they will also when sensitized show different vibratory disturbances specific for every disease that affects the blood—then we take too much for granted. And that is the way with the quacks. The mere fact, however, that quacks have prostituted the electronic concepts to swell their conscienceless coffers is not hindering the legitimate inquiry into the same field of endeavor.

For it is known that there are tremendous possibilities along this and kindred lines—and scientists are making rapid progress with the little potential being that they call the *electron.*

This is the tiny creature so small that it passes through solid iron walls as readily as a cootie through a Victory arch, the same tiny creatures that Marconi and his coworkers harnessed and put to work in the radio. So now in our homes, at least in the homes of those of us who have felt the sting of the radio bug, billions of these little electrons are daily employed to carry on their backs and into our ears, messages broadcasted from all directions. And according to the oscilloclastic quacks, who can do so much with a drop of blood, it is this little electron that especially whispers in their ears the mysterious diagnosis and cure of all the ailments of mankind.

A straw that shows the drift of legitimate investigative currents towards the electronic oceans is the following extract from a recent publication by Prof. W. J. V. Osterhout, of Harvard, called "Inquiry, Recovery and Death." This book describes a new way to measure the vitality in living things by a simple electric test. Prof. Osterhout finds that protoplasmic cells, which includes the blood cell—and they are essential structures in all living things—offer considerable resistance to the passage of an electric current through them while they are fully alive, less resistance when they have been injured or reduced in vitality in any way, and much less when they are dead. By this test he has been able to measure the degree of vitality, the probability of recovery after injury and the certainty of early death of the cells. His investigations, however, have been made with the cells of certain sea weeds, which after all are not so different from our very own, for all of us have come from a sea-living ancestry. He finds that whatever alters the electric conductivity of plant or animal tissues, whether it be a crushing blow, too much heat, lack of air, lack of water, presence of poisons or anything else injurious, will impair or shorten the life of the organism. But for all his scientific ability, Prof. Osterhout does not overestimate the value of his work. He appreciated its limitations. He knows that tomorrow is the day of the electron, and that there is too little known about it today to justify any prediction or prophecy as to its ultimate possibilities and potentialities. Only the quacks claim to have harnessed it today, and in their hands the little electron is abused and paraded before gullible neurotics as a means of diagnosing and curing the ills of all mankind.

But " 'twas ever thus" and the charlatan has never missed an opportunity to use the legitimate means to an illegitimate end. Very recently a pseudo-scientist in the Middle West earned himself much subtle advertising by announcing in the newspapers that he was ready to demonstrate the paternity of a young child, about whose person a loathsome and scandalous court suit had been instituted. One drop of the child's blood, a drop of the blood of each of the parents, was all that this man said was necessary to establish without doubt the legitimacy of the issue.

A *bona fide* scientific inquiry into this subject, however, does not afford any specific test that might be used to this end. It is admitted, in blood typing, that the specific agglutinogens never appear in the offspring unless they are present in the blood of one of the parents, and what is really inherited then is the presence or absence of the several agglutinogens. This fact has led to the establishment of certain algebraic formulas which may be worked according to a dihybrid Mendelian scheme, and whereby the blood type of a parent may be established from the blood type of the offspring and of the other parent. But this test is entirely too hypothetical to stand the cold-blooded investigation of a thinking court. So science is still working at it, while the quack is braying and finding a responsive audience.

We come now to the part which is played by the much advertised and much misunderstood endocrines or gland secretions. Situated here and there in the blood avenues are little factories called the ductless glands, and into the passing currents of blood these tiny mills pour out their precious products. The chemical substances delivered into the blood stream by these glands affect every cell in the body. Their secretions with their influence upon the brain and nervous system, as well as every other part of the body corporation, for they are essentially blood-circulating chemical substances, have been discovered to be the sole arbiters of our several attributes. They determine our temper and temperament. Tall or short, bright or dull, thick or thin, it's their decision. They curve our figures, cut our wrinkled lines and dominate our characters. A sprinkling of this hormone and a dash of the other is the only difference between the cavalier and puritan, the polished scholar and dull buffoon, the crude costermonger and the wizard of finance.

And oddly enough modern knowledge of these chemical substances in the blood dates back scarcely half a century. But already

the paths blazed by the pioneers in the quest are leading straight to marvelous lands. The thyroid gland, the thymus gland, the adrenals, the pineal, have all yielded great secrets and will continue to yield more as the years go on.

The ductless glands have been described as little chemical factories with an intricate system of cellular departments. To these factories the red cells of the blood convey the crude products which are promptly put through the retorts and furnaces of the glands, and are changed into the complex chemical substances which we call hormones. These hormones are then broadcasted back into the blood stream and minister with varying effect upon the tissues of different parts of the body. The pituitary gland plays directly upon the brain cells, the suprarenals work first upon the heart, and so on.

In the neck region is the thyroid gland, a factory producing a chemical called Thyroxin. This chemical and its related compounds have a specific function in the body. They control the energy production of the machine as well as the growth of certain organs and tissues. This is particularly true of the brain. From another viewpoint the thyroid factory may be looked upon as supplying the body with its uniform quota of iodine, that important elemental constituent that seems to exercise such a profound influence upon the animal economy. This gland, when it is working sanely, liberates just enough iodine out of the crude products which come into its factory, so that there may be maintained in the blood just about as much iodine as there is in sea water. Ever since we have evolved out of the jelly fish that lazily tossed about on the crest of the salty ripples, Nature has decreed that we should not be lifted too far from our humble infusorial grandparents, and so instead of the sea water floating about us, it now reminds us of its importance by floating inside us. Indeed our very blood is nothing but sea water, to which has been added a little hemoglobin as an oxygen-carrying pigment to supply the far-off cells that are out of atmospheric contact.

The abnormalities caused by an overworked or an underworked thyroid gland are too numerous to mention here, but there has leaked into the lay mind an erroneous idea that all fat persons are fat because the thyroid has closed down its factory. Patent medicine vendors have played up this idea and they now offer to the unwilling fat carrier a remedy which they claim will harmlessly but

surely melt off the excess fat without discomfort to the erstwhile carrier. These obesity "cures" all contain the thyroid gland of an animal, and they work by activating the body fires so that the fatty fuel is burnt off. Danger comes, however, in that the fire that consumes the fat also hurts the other body substances such as the protein, which takes so long to organize and knit together. Thyroid should not be self-administered—it is much too potent a medicine to place in lay hands. Even the doctors hesitate to use it, just for reducing physical ponderosity. They know that not all fat persons are fat because of thyroid shortage. Does not the poet sing that

> "Some grow fat with faulty fare,
> And some grow fat with laughter"?

The pituitary gland is a tiny laboratory resting snugly in the centre of the brain. So important to the human machine is this gland that the great Designer placed it inside a bony couch within the bony skull, a sort of a double protection as it were. It is divided into two manufacturing departments, one, the posterior plant, building up a chemical substance called tethelin; the other manufacturing a very important compound called pituitrin, both of these chemicals now largely utilized in medicine. This gland as a whole has no small task to perform, for its activities are said to control the consumption of body energy, just as the thyroid controls its production.

The poetic Berman, whose excellent and picturesque book on the glands is now a standard, also blames the pituitary gland for being the laboratory whose flasks and crucibles turn out that all-important human emotion called love. He dares to give Love a chemical formula. So many O's, so many C's, so many N's, but no I's (for Love was always blind). All through the animal world, says he, in the springtime, when the sleeping pituitary reopens its plants and increases its products in the blood stream, emotions of love are provoked, and all the world goes wooing. When the nightingale warbles and the mocking bird gurgles, when the robin fills its scarlet breast and the starling floats in ecstasy through the perfume-laden air, all are calling for their mates, and all because of love—love in the blood—manufactured unconsciously by a few hidden cells. The calf-like symptoms of love have long been known, but the chemistry of its toxins is still a pretty hypothesis.

Sitting astride the kidneys is the bi-departmental adrenal gland. Out of this factory comes the subtle product called adrenalin, perhaps the best known of all the internal secretions. This substance largely controls the whole body balance. Hypothetically the adrenal gland is the central establishment in the gland chain of factories. It energizes, stabilizes and synchronizes the efforts of the other plants. It is also said to fit the body for emergency situations, to "stiffen up the sinews and summon up the blood."

The Thymus gland, clinging to the windpipe, is the gland of childhood. It is the gland whch keeps children children, and whose activities prevent the too rapid maturing of the young. After puberty this gland becomes atrophied and disintegrates, and its dismantled laboratory no longer pours its substance into the blood. Thus Youth comes only once and the poet knew this full well, as he sang:

"For when youth the dream departs
It takes something from our hearts,
And it never comes again."

The parathyroid glands are situated in the neck behind the thyroid glands. Their output largely controls the mortar and cement business of the body, the calcium metabolism. They also control the excitability of the nerves and muscles.

The pancreas is now considered a gland of internal secretion. Its chemical product, called insulin, has been lately isolated and promises revolutionary results in the treatment of diabetes. Insulin is really not a new discovery, for it has been long known theoretically at least, as the controller of the sugar metabolism of the body. Only its separation and isolation, as well as its specific use in the treatment of disease is novel.

In medicine this might be termed the endocrine period for the doctors are putting to test without mercy the old Hahnemannian concept, *Similes curantur similibus.* Nearly all human ailments are blamed on some over- or under-functioning gland, and to combat the deficiency or excess the respective gland product for a lower animal is used. Some good results are obtained, but on the whole the business is still a fad, and may have worked more harm than good, for there is no one to judge. It is all a matter of empiricism.

Now comes the chemist and tells us with definiteness all of these gland secretions are only chemical compounds which can be

duplicated with products made from coal tar and its various derivatives. Pretty soon he claims he will duplicate them all, and then a gland that fails to function right will lose its place and right to serve. So we can now hope for the day when we will carry a vest pocket case containing the chemist's supply of compressed hormones and thus regulate at will our varied passions. Until then, however, we must depend upon the stock yards to supply our functional deficiencies with crude and empiric extracts of glands from pig or cow or gentle sheep.

Or perhaps we may turn to the newer fashion of excising a gland from some forlorn lower animal and replace our activeless gland with this foreign implantation, or perhaps we may, from a brother of our own race, purchase his birthright glands for a mess of golden pottage and so hope to bring back to us fair youth and fire. Unfortunately, however, these experiments are lacking in good results when tried on man. Implantation from the anthropoid apes works best, and thus another brick at Bryan. In all cases, however, the relief is only temporary, and the borrowed gland promptly succumbs to the same influences that rendered impotent the natural, original organ. The Elixir of Life is still unanalyzed, and the Fountain of Youth is still at the foot of the rainbow.

That the endocrine gland has also made an impression on our national literature is shown by the following quotation of a bit of verse from that satirical institution called *Life:*

A Modern Gent to a Modern Lady.

If some day I beam on you
  And gently squeeze your hand,
It's 'cause you've proved attractive to
  My pituitary gland.

And if I whisper in your ear,
  "'Mong roses you're my bud,"
It's not because I love you, dear;
  It's adrenal in my blood.

And if I trust you with my life,
  And pen you throbbing lines,
Don't think I want you for a wife—
  I just lack vitamines.

So that no one of us may carry away too exalted an opinion of oneself the following data, which originally appeared in an insurance journal, may serve the purpose well. The nursery rhyme used to teach us that we are made of "scissors and snails and puppy dogs' tails," or "sugar and spice and everything nice." Not so with chemistry, however. Here is the total humorous composition of the creature called man: Fat enough for seven bars of soap, sugar enough to sweeten two cups of Child's coffee, lime enough to whitewash a cellar around the bottles, phosphorous enough to make four boxes of matches, magnesia as much as the druggist sells for a nickel—and that is not much—iodine enough to paint a pimple, and sulphur enough to rid a dog of fleas. Many items in this estimate are left largely to the imagination, such as the size of the dog and the number of his tormentors, but the total cost is given, *a la* Lit, as 98 cents, which is neither expensive nor calculated to foster conceit.

Luden has, however, called attention to the fact that "in physiology we get so close to the details that we obscure the whole, so close to the forest that we cannot see the woods for the trees. These quantitative facts regarding the body's make-up are somewhat startling. For example, the entire volume of circulating blood, which about half fills an ordinary bucket, contains only a small teaspoonful (from 4 to 6 gm.) of sugar and a tablespoonful (32 gm.) of salt. When we consider the minute variations in the sugar content that the modern chemist can measure in a few drops of blood, we gain added respect for the science of quantitative analysis. The iodine in the entire blood amounts to but 0.01 gm., or an average dose of atropin. When the physiologist tells us that adrenalin can be detected by biologic methods in a dilution of 1:330,000,000, it means far less than to say that it is equivalent to diluting 'a small glass of whisky (10 cc.)'—a very small glass, that—into the contents of 1320 city street sprinkling carts, which would form a procession about six miles long. We all know that the normal blood contains about 5,000,000 red corpuscles in each cubic millimeter, but do we all realize that the entire blood must therefore contain some twenty-five trillion red cells and thirty billion white cells, figures that have an astronomical aspect? If mental pictures of the billions and trillions of blood cells crowding, jostling, and possibly struggling for a share of the mere teaspoonful of sugar in the total blood volume of a full-sized man, or the endless procession of sprinkling carts represent-

ing the adrenalin concentration to which animal tissues respond, appeal to one's sense of humor, they also do much more than this: They bring home the delicacy of the adjustment by which the human body mechanism is regulated; the extent to which this fine adjustment may be disturbed by seemingly trivial factors; the obligation of both laymen and physicians not to ignore the 'slight' tokens of distress of the body engine." And the regard which we must all have for the Infinite Mind, whose eye is on the sparrow and who also watches us.

REFERENCES.

Physiological Chemistry; Bünge, *The Glands Regulating Personality;* Berman, *Journ. Amer. Med. Assoc.; Science Service.*

THE EVOLUTION OF CHEMICAL TERMINOLOGY.

IV. THE THERM.

By James F. Couch.

The recrudescence of the word "Therm," indicated in recent news from England,[1] recalls the great confusion and ambiguity that envelopes the use of that term. There apparently has been a change made in London in the method of computing charges for illuminating and fuel gas; instead of the old system of basing charges upon the number of cubic feet of gas consumed, it is now proposed to use the heating value of the gas as the measure and the bills rendered will be founded upon the number of British Thermal Units (B. T. U.) actually consumed. This change seems to substitute quality for quantity and, in so far as it does, it is to be recommended. The unit chosen to supersede the cubic foot is the therm and this is specifically defined as 100,000 B. T. U. for the gasometric purpose.

The word therm has, however, been used in a variety of ways until it has lost all definiteness. On this account it presents a source of confusion and error and should, therefore, be either restricted to some definite concept or should be discarded altogether. Its continued use under the present circumstances is not in harmony with scientific precision.

[1] *Chem. Age* (Lond.), 7, 915 (1922).

Let us examine the history and the various meanings of the word. Webster's Dictionary [2] defines the term thus: "Therm. The greater calorie equal to 4.2×10^7 ergs. . . . Sometimes also, a, the small calorie. b. A practical unit equal to 1000 great calories." The Century [3] Dictionary says: "2. In physics, a thermal unit, the water-gram-degree or (small) calorie." Murray [4] presents this definition: "A proposed unit of heat: the quantity of heat required to raise the temperature of one gram of water at its maximum density one degree centigrade." Funk and Wagnall's [5] defines the term as: "1. Physics. The amount of heat required to raise one gram of water at its maximum density one degree centigrade. 2. A heat unit (1) Usually the gram-calorie (2) the kilogram calorie. (3) [t or T] One thousand kilogram calories." Dorland [6] gives this definition: "A heat unit; the amount of heat needed to raise one gram of water through one degree centigrade: 1,000 calories."

Henry and Morrison [7] define the therm: "A *therm* (T) is 1,000 Calories, or the amount of heat required to raise 1,000 kilogram of water 1° C., or 1,000 lbs. of water nearly 4° F." Thomas Gray [8] says: "The therm is the quantity of heat required to raise the temperature of one gramme of water 1° C." Several years ago I published the following comment upon this term: [9] "Therm. A unit of heat equivalent to 1,000 large calories used in expressing the calorific value of feeds. The value for the therm is also given as equal to the small calorie. There appears to be no real necessity for this unit." As it stands today, then, the word therm may mean one calorie, or one thousand calories, or one million calories, or one hundred thousand B. T. U. which is three hundred ninety-six million calories.

Aside from the above weighty objection the term conflicts with the word "Thermel" proposed by W. P. White [10] as a name for the thermocouple or thermoelectric thermometer, and the abbreviation T

[2] "New International Dictionary of the English Language," 1919, p. 2142.
[3] "The Century Dictionary and Cyclopedia," v. 9, p. 6281 (1911).
[4] "A New English Dictionary on Historical Principles," v. 9, pt. 2, p. 288.
[5] "New Standard Dictionary of the English Language," 1913, p. 2500.
[6] "The American Illustrated Medical Dictionary," Ed. 11, 1921, p. 1085.
[7] "Feeds and Feeding," Ed. 16, 1916, p. 44.
[8] "Smithsonian Physical Tables," 1896, p. xxiv.
[9] "Dictionary of Chemical Terms," 1920, p. 185.
[10] *Science*, v. 55, p. 617, June 9, 1922.

proposed for therm conflicts with the widely used and firmly established abbreviation T for absolute temperature.

The word therm as a heat-unit was first proposed by a committee of the British Association for the Advancement of Science appointed "for the purpose of constructing and issuing Practical Standards for use in Electrical Measurements." The committee reported to the 1888 meeting at Bath, as follows:[11] "At the last meeting of the Committee it was resolved, on the motion of Mr. W. H. Preece, to adopt the name 'Therm' for the Gramme-Water Degree-Centrigrade Unit of heat. Thus one 'Therm' is the quantity of heat required to raise one gramme of water at its maximum density one degree Centigrade. . . . Hence, also, if we take the value of the mechanical equivalent of heat as 4.2×10^7 ergs, we have 1 Therm = 4.2 Joules."

The fate of this suggestion is forecast by the following note from "Nature," published three months after the meeting of the British Association:[12]

"The term 'therm' in place of the calorie, for the unit of heat in the C. G. S. system, has not met with general approbation, as the other names applied to the units have done. It was, perhaps, hastily accepted; but has it occurred to the dissentients that it might be dispensed with altogether, and that the unit of work, 'Joule,' answers all the purpose of a unit of heat? There are 4.2 Joules in a therm. They are of the same dimensions, and really indicate the same physical quantity, *viz.*, the mechanical equivalent of heat. Calorie will, however, perhaps hold its own, now that the C. G. S. system is so generally adopted. The only reason that led to the acceptance of the therm was the confusion arising from the kilogramme-degree, as well as the gramme-degree being called a calorie, but the former is fast going out."

In the following year Forbes and Preece[13] reported:

"The Therm as the unit of heat, which was proposed by the British Association Committee at Bath last year, did not commend itself to the French members (of the Electrical Congress at Paris). They preferred for the present to retain the term Calorie, notwithstanding the confusion from there being two units of that name. It is said there is only one Calorie in the C. G. S. Centigrade system.

[11] *Report Brit. Assoc.*, 1888, p. 56.
[12] *Nature*, v. 39, p. 159, Dec. 13, 1888.
[13] *Report Brit. Assoc.*, 1889, p. 514.

"But the question arose—Is there any need for either the Therm or the Calorie? Cannot the Joule be made a thermal unit also, for the latter is only a unit of work? The heat generated in T seconds by C amperes flowing through R ohms (or driven by E volts) is $C^2RT = ECT$ Joules. If we take the mechanical equivalent of heat as approximately 42,140,000 ergs, or 4.2 Joules, it means that 4.2 Joules will raise one gramme of pure water at 4° C. one degree."

In 1895 Dr. Guillaume, of the Bureau International des Poids et Mesures, at Sèvres, wrote: "I believe that if the French Committee adopt your proposal as to the fixing of the new unit, they will declare themselves still more decidedly in favor of the name which you have given them, as it has already been proposed here to name 'therm' the equivalent of heat of the erg or of one of its decimal multiples." [14]

Dr. Wüllner [15] stated in 1896 that "the name 'therm' is suitable for English physicists, but not for others."

The proposed term met with so little favor that it never came into general use in spite of the fact that there was and still is a dangerous source of confusion between the large and small calories which the use of the therm in its first proposed sense would have largely removed. Even this would not, however, have justified the adoption of the therm for the possibility of misapprehension of the Calorie might better have been removed by terming the large or kilogram Calorie the kilo- or mega-calorie. Indeed this action is clearly indicated; a similar condition which existed in the case of the joule has been removed by careful writers through the adoption of the kilojoule as the name for the larger unit.

The fact that the word therm is now established commercially in Great Britain to express that quantity of illuminating or fuel gas which shall have a calorific value of 100,000 B. T. U. coupled with the fact that there is no single specific meaning for the term generally agreed upon, and further since physicists have decided that they have no real need for the term, all indicate that as far as science is concerned the word should be discarded and if used at all in the future it should be taken to mean 100,000 B. T. U. It is evident that the number of people who shall use the word in the latter sense and the

[14] *Rep. Brit. Assoc.*, 1896, p. 158.
[15] *Ibid.*, p. 156.

frequency of its use in that way will be enormously greater than will use it in any other sense.

The large Calorie has been used by physiologists, physicists, and all other investigators in thermal phenomena whether of metabolism, of friction, of chemical change, or of electrical action, and it has been adequate for all of these purposes. Even if it were necessary to replace it by some other term the word therm would not be suitable on account of the confusion of meaning which would be certain to arise. As long as the connotation of a term will continue to depend upon the whim of him who uses it or upon the caprice of an isolated "committee on nomenclature" just so long will there be indefiniteness, ambiguity and confusion in scientific terminology.

Summary.

The word therm has recently been adopted in England as a measure of illuminating and fuel gas and has been specifically defined as equivalent to 100,000 B. T. U. This term has been used previously in a variety of ways as a measure of heat and has been, at various times, assigned values of from one to one million (small) calories. As far as the needs of thermodynamics are concerned the therm has no excuse for existence for the quantities which it denoted are amply specified by the term calorie. The term should, therefore, be discarded when thermal science is in question and should be specifically related to the commercial measuring of fuel gas for the purpose of computing charges.

THE IRON CONTENT OF LETTUCE.†

By Aaron Lichtin, Ph. G.

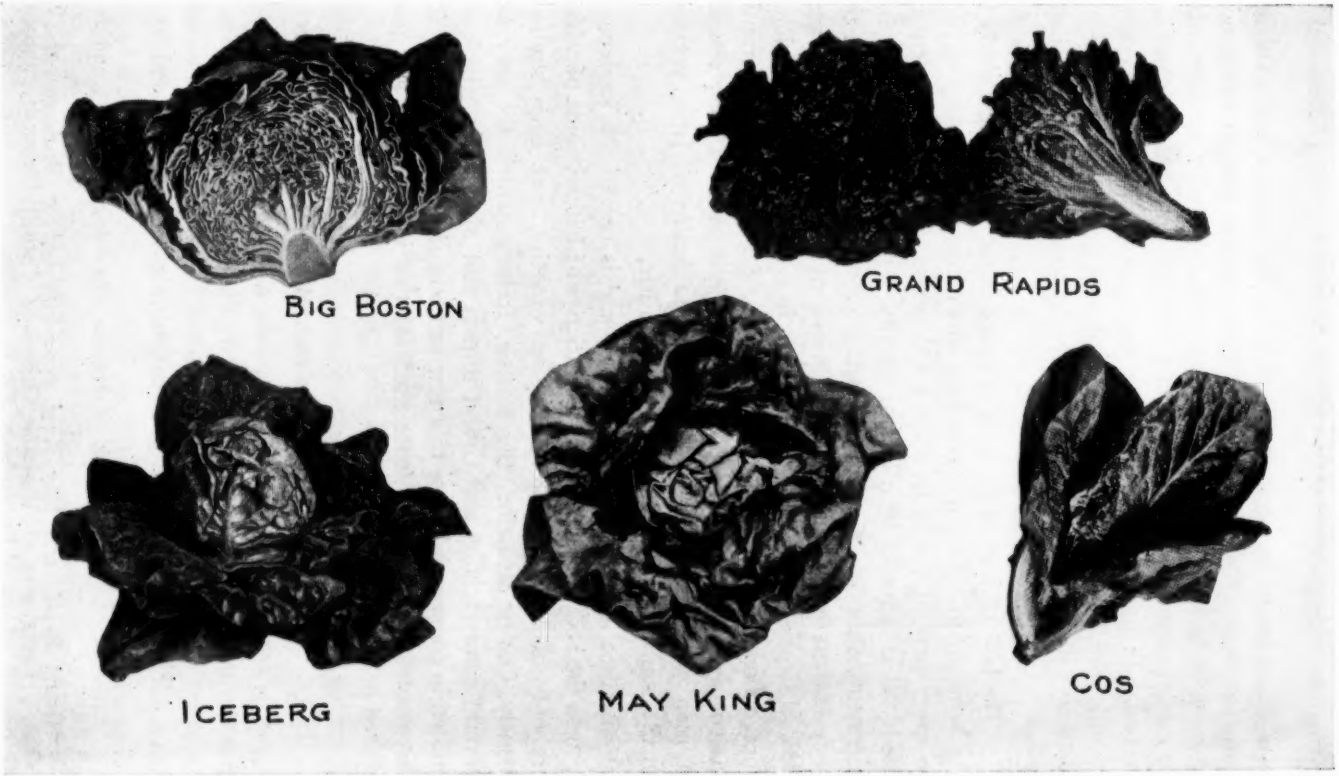
I. Introductory.

The purpose of this investigation is: (1) to verify the meager data published on the iron content of lettuce,[1] and (2) to offer a quantitative method for its determination.

It has been experimentally established that iron in food, in organic combination, is of great value to the human body. Inorganic (medicinal) iron is of relatively little value to the body, as it is not

† Graduation Thesis, Philadelphia College of Pharmacy and Science. 1922.

[1] Sherman in his book "Chemistry of Food and Nutrition," p. 424, gives 0.0007% as figure for iron content of lettuce, but no data as to how figure was obtained.


BIG BOSTON
GRAND RAPIDS
ICEBERG
MAY KING
COS

in a condition to be directly absorbed by the system, but combines with the hydrogen sulphide gas in the intestines and in this condition cannot be absorbed. Organic iron, if in too small a quantity, may be entirely transformed into ferrous sulphide and therefore not absorbed. In mixtures of inorganic and organic iron, or excess of organic iron, the inorganic or excess of organic Fe by removing the sulphur will enable the organic iron to be absorbed by the small intestine.

The bulk of iron in the body is found in the blood, particularly in the hemoglobin, where it serves as a sort of catalyst to carry oxygen to every part of the body. Thus a decrease in the iron content of the blood is followed by a loss of vitality, a pale complexion, an impairment in the functions of oxidation. A deficiency of iron in the body is therefore associated with diseases of the blood, such as anemia, chlorosis, etc. "Chemic analysis has shown that hemoglobin contains 0.42% and blood 0.056% of iron." [2] The quantity of iron in humans is very small, only one part in 25,000 parts of body weight. A man weighing 150 pounds contains 42 grains of iron, yet this small quantity of the metal is essential to life.

Lettuce is widely used as a food, and is one of the sources of iron to the body. There are many varieties of lettuce, some of which are only of botanical interest. Five varieties have been studied; namely, Cos or Romaine, Big Boston, Iceberg, which are very important commercially, and Grand Rapids and May King, which are limited in commercial value to a few sections of the country. By far the greatest part of the lettuce used for this investigation was purchased in the open market.[3]

II. Experimental.

The edible portions of the heads were washed and then desiccated in a drying oven to constant weight at a temperature varying from 95 to 97° C. Care was taken to avoid contact with metallic surfaces. The dried material was comminuted and incinerated in a

[2] Brubaker, A. P., Textbook of Human Physiology," pp. 243 and 244, 4th Ed.

[3] Grand Rapids and May King were furnished by Professor H. W. Schneck, Department of Vegetable Gardening, Cornell University, through the courtesy of one of his students, Mr. W. Rudley.

silica dish protected from dust and air currents. The resulting ash was then weighed and stored in glass-stoppered bottles. A quantity of ash of each variety was carefully weighed in a tared Erlenmyer flask, and measured quantities of strong H_2SO_4 (95.6%) and distilled water were added to each flask. The mixtures were kept boiling for one hour; after cooling the mixtures were filtered and the filters washed with distilled water to make the filtrates measure either 75 or 100 cc. (Table I).

A standard iron solution was prepared by dissolving 210 milligrams of Fe $(NH_4)_2$ $(SO_4)_2$ $6H_2O$ in 50 cc. distilled water and 7.5 cc. 20 per cent. H_2SO_4, then oxidizing the ferrous salt with $\frac{N}{10}K_2Mn_2O_8$ solution and diluting to 300 cc. Each cc. of this standard solution contains 0.0001 gm. of iron. Three color standards were prepared by mixing for A 10 cc., for B 1 cc and for C 0.2 cc. of the standard iron solution with 10 cc. $\frac{N}{1}$ KCNS solution and then diluting to 100 cc. with 10 per cent. H_2SO_4. Therefore color standard

A contains 0.001 gram of iron in 100 cc. of solution.

B contains 0.0001 gram of iron in 100 cc. of solution.

C contains 0.00002 gram of iron in 100 cc. of solution.

As the standards deteriorated rather rapidly, a fresh color standard was prepared for each determination.

A portion of the acid extractions of the ash was each placed in a burette graduated to 0.1 cc., and allowed to drop into a Nessler jar (A. P. H. A. type, of the same internal diameter as the jar which contained the color standard), containing 10 cc. H_2SO_4 iron free, 10 cc. KCNS and water to make about 90 cc. The colored solution which was formed by the dropping of the liquid from the burette was compared and matched with 100 cc. of the nearest color standard (A, B or C). The quantity of the liquid dropped was noted and the quantity of iron in the acid extraction calculated according to this formula:

$$\frac{\text{Gms. Fe in color standard} \times \text{cc. total acid extraction}}{\text{cc. acid extraction used in experiment}} = \text{Gms. Fe in acid extraction}$$

TABLE I.

Kind of Lettuce.	Weight of Edible Part.	% Moisture.	Weight of Ash.	% of Ash.	Weight of Ash Used in Iron Determination.	Solvent Employed for Extraction of Iron.
Big Boston	2623.0	94.58	26.721	1.011	11.5192	25 cc. H_2SO_4 (95.6%) + 75 cc. H_2O
Iceberg	3250.0	95.98	20.130	0.619	11.0059	
Cos	4253.2	94.93	21.980	0.514	12.8730	
May King	581.2	94.45	6.684	1.150	6.6840	12.5 cc. H_2SO_4 (95.6%) + 62.5 cc. H_2O
Grand Rapids..	813.5	95.55	5.438	0.668	5.4380	

TABLE II.

Indicating Results of Iron Determinations.

Variety.	Color Standard.	cc. Ext. Used.	Gms. Fe Indicated in Extract.	Gms. Raw Material (Edible Part) Represented.	Maximum and Minimum Indications.	Average % Fe for Variety.
Big Boston	B 1	0.35	0.028111	1125.467	0.00250	0.00272
	B 2	0.30	0.032873	1125.467	0.00294	
Iceberg	B	0.35	0.028111	1774.823	0.00154	0.00189
	C	0.05	0.039954	1774.823	0.00225	
Cos	C	0.25	0.007954	2492.375	0.00031	0.00033
	A	11.85	0.007788	2492.375	0.00035	
Grand Rapids..	A	3.05	0.024390	813.50	0.00299	0.00301
	B	0.30	0.024770	813.50	0.00304	
May King	C	0.10	0.014770	581.00	0.00254	0.00326
	A	3.10	0.019740	581.00	0.00399	

Average % = 0.00224%

The average figures obtained by this method were checked by titrating with $K_2Mn_2O_8$ solution. Ten cc. of the acid extraction of each variety were mixed together, after reducing the ferric salt to ferrous salt by means of metallic zinc, and titrated with $\frac{N}{10}$ $K_2Mn_2O_8$ solution in the usual way.

TABLE III.

$K_2Mn_2O_8$ Titrations.

cc. of Ext. Used.	Gms. Raw Material Represented.	N/10 Sol. Used.	Gms. Fe Indicted.	% Fe.	Average %.
50	725.1994	2.6	0.014518	0.00201	0.00203
50	725.1994	2.7	0.014876	0.00205	

Average % for both methods 0.00213.

III. Conclusion.

Lettuce, one of the staple articles of our diet, contains iron. With an average salad of about 25 grams one consumes about 0.5 milligram of iron. May King variety is richest in iron. Of the more important commercial varieties Big Boston is richest (0.00972 per cent.) and Cos is poorest (0.00033 per cent.) in this element. The average iron content of lettuce in this investigation is 0.00213 per cent., which varies considerably from the figure given by Professor Sherman.[4]

REFERENCES.

1. Sherman, H. C., "Iron in Food and Its Function in Nutrition," Bul. 185, Dep't Agriculture, Office Exp. Station.
2. "Methods of Analysis," U. S. Dep't Agr., Bur. Chem., Bul. 46.
3. Treadwell and Hall, "Analytical Chemistry," Vol. II.
4. "Library of Technology," Int. Corresp. Schools, Vol. 146.
5. Sherman, H. C., "Chemistry of Food and Nutrition."
6. König, J., "Chemische Zusammensetzung der Menschlichen Nahrungs- und Genussmittel," 1903.
7. Leach, A. E., "Food Inspection and Analysis."
8. Lloyd, J. W., "Productive Vegetable Growing."
9. Moerk, F. X., "Quantitative Analytical Chemistry."
10. Brubaker, A. P., "A Textbook of Human Physiology."
11. Woodman and Norton, "Air, Water and Food."
12. Bunge, "Physiological and Pathological Chemistry," Ch. 25.
13. Scott, W. F., "Standard Methods of Chemical Analysis."
14. *U. S. P.*, IX.

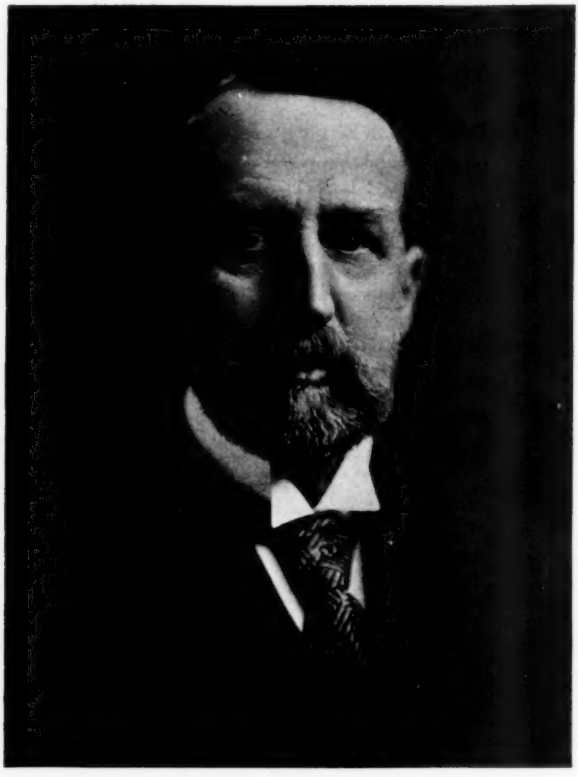
OBITUARY

CLEMENT BELTON LOWE.

It is always difficult to convey to those to whom our associates were not intimately or personally known an idea of their individual merits, and those traits of character which endeared them to us. We seldom see the heavy crosses which others bear, how sorrowful at times their lives are, how great the burden of their troubles. So it is quite appropriate to pause when one whom we have long known has left us, and look back along the paths we have traveled together and reflect on his excellences—the light and perspective change.

[4] "Chemistry of Food and Nutrition," p. 424.

Clement Belton Lowe lacked only three years of the age of fourscore, having been born at Salem, N. J., the son of Rev. Samuel and Harriett Newell (Belton) Lowe, April 30, 1846. Clement's early education was received in the little red schoolhouse of his home town, and he passed from there to Bucknell University,



CLEMENT BELTON LOWE.

Lewistown, Pa. In 1863, while a student at the latter institution, he enlisted in Company A, 28th Pennsylvania Militia, and, later, became orderly sergeant attached to General Couch's staff. He graduated from Bucknell University in 1865 with the degree of Ph. B., and the next year entered the Philadelphia Polytechnic College with the intention of becoming a civil engineer, but ill health compelled him to relinquish the purpose. In 1867 he engaged in the drug busi-

ness with William Lippincott at Ninth and Vine Streets, and succeeded to the sole ownership of this store, which was continued by him until 1895; in 1899 he bought the Pelham Pharmacy in Germantown, which he conducted until 1914. He graduated from the Philadelphia College of Pharmacy in 1884, and from the Jefferson Medical College three years later.

The desire to gain more knowledge and be better qualified for larger service is not restricted by years, but the willingness to strive for knowledge when the opportunities are not as convenient and sacrifice must be made to studiously apply one's self represents a quality of courage that is much rarer than other valor. He asked for no special considerations from the faculty nor from his classmates because of his seniority; he always acknowledged himself a debtor to his profession and continued to discharge that debt until very near the close of his life with the resolve to give his very best in the service.

The Alumni Association of his Alma Mater elected him quiz master of materia medica and botany soon after his graduation, and in 1886 he became assistant to Professor John M. Maisch, and later to Professor Edson S. Bastin, whom he succeeded as professor of materia medica; in 1921 he resigned as active member of the faculty, and his services were recognized by his election as professor emeritus of materia medica; an honorarium was voted him, and as a further expression of love and esteem he was presented with a beautiful and valuable gift by the members of the faculty and officers of the college.

Dr. Lowe was a member of the Executive Committee of the Alumni Association, P. C. P., for a decade, and its president during the year, 1888 to 1889. As chairman and member he served on important committees of the Pennsylvania Pharmaceutical Association, and in 1907 as president. He was secretary and chairman of the Section on Education and Legislation of the American Pharmaceutical Association, 1899 to 1901, and vice-president in 1909. He was editor of the *Alumni Report* for a number of years, author of "A Syllabus of the Botanical Natural Orders," and editor of a volume on "The Medicinal Plants of the Philippines."

Mrs. Lowe was Abigail Ann Allen, born in Bridgeport, N. J., December 2, 1847, and March 17, 1921, was the golden anniversary of her marriage to Professor Lowe. On January 23d Mrs. Lowe preceded her husband to the life beyond, and, on February

5th, yielding to time, he passed out of this life quietly and peacefully to meet her with whom he had shared joys and sorrows for so many years.

Two sons, Allan Guilford and Clement Wakelin, and two daughters, Viriginia and Elsie, were born to the deceased. The former are living in Vineland, N. J. The daughters had arrived at young womanhood and frequently accompanied their parents to association meetings and were, therefore, known to many members of these organizations. While spending their vacation at Ocean City and in bathing (July 31, 1900) with friends and their younger brother, they were overcome by the current and with others of the party were drowned; Clement, Jr., came very near suffering the same fate. Although overwhelmed with anguish and at a time when they were growing old and full of hope for their children's happiness, the parents bore their distressing affliction with patient courage and resignation. "Faith built for them a bridge across the gulf of death and broke the shock which nature could not shun."

This memorial would be incomplete without reference to the church and Sunday school work of Dr. Lowe, in which from boyhood he took an active interest. He was a deacon of the Baptist Church, and at his funeral his former pastor, Rev. Charles Hastings Dodd, of Germantown, spoke in beautiful terms of appreciation of the unfailing service given to him by the deceased. He commented on his life as—complete, fully rounded and intellectually gifted—an interesting life, full of ambition to excel and be useful—a faithful, loving and sympathetic life, deeply and sincerely religious.

In making a change of residence, the quality of Dr. Lowe's service for church and Sunday school was invariably recognized in the capacity of deacon, teacher and superintendent, and for a time he was president of the Baptists' Superintendents' Association of Philadelphia. He considered that labor and prayer nerved the spirit afresh.

Unto all of us losses and mortifications and sufferings also come—none of us are relieved of the liability to the sorrows, the distresses and the calamities of life, but we do not all bear our burdens in the same way. The sky of the afternoon of our frater's life was not free from clouds and darkness, but after the setting of the sun the mellow glories of the evening sky are brilliant and beautiful.

E. G. Eberle.

ABSTRACTED AND REPRINTED ARTICLES

THE ESTIMATION OF CODEINE.*

By Harold Edward Annett, D. Sc., F. I. C., and Ram Richhpal Sanghi.

The present paper is to be regarded as a continuation of one already published (Annett and Sen, *Analyst,* 1920, 45, 321). We have improved and simplified the method there described for the estimation of codeine. The basis of our method is the same, but we have omitted the basic lead acetate treatment.

Modified Method.—The following is the procedure now recommended: Eight grms. of opium are triturated with 2 grms. of slaked lime and 80 cc. of water during half an hour, as in the B. P. (1914) process. Fifty cc. of the filtrate (=5 grms. of opium) are extracted with three successive portions, each of 50 cc., of toluene. The toluene from each successive extract is passed through a dry filter into a distillation flask. It is then concentrated under diminished pressure to a small bulk (about 25 cc.), and dry hydrogen chloride gas bubbled through it for half a minute. Codeine hydrochloride rapidly separates in a flocculent form, together with colouring matter, etc. The toluene is filtered through a dry filter, the codeine hydrochloride dissolved in water and the solution filtered through the same filter into a small round-bottomed glass dish, a deep magenta colour developing. The liquid is then evaporated on the water bath. When almost dry, the dish is transferred to a water oven and dried to constant weight. This treatment renders the colouring matter insoluble, as required in the next process. The substance is now dissolved in hot water and transferred to a 50 cc. flask, the volume made up to 50 cc., 0.2 grm. of fresh slaked lime added, and the flask shaken during half an hour. The liquid is then filtered, and 40 cc. (=4 grms. of opium) are taken for extraction with three successive portions, each of 40 cc., of toluene. The toluene is filtered through a dry filter into a distillation flask, as before, each portion of toluene being put through

*Reprinted from the *Analyst.*

the filter immediately after extraction. In this way the final filtration is of the toluene least concentrated in codeine. Finally the filter paper is washed with a small amount of toluene. The toluene is concentrated to a small bulk (about 25 cc.), as before, and dry hydrogen chloride gas passed through it for half a minute. The toluene is filtered off, the codeine hydrochloride dissolved in water, and the solution filtered into a small weighed round-bottomed glass dish. The liquid is evaporated almost to dryness in a glass dish and now develops practically no colour. When only a small amount of water is left, a little weak alcohol is added to encourage crystallisation, and rosettes of almost colourless crystals of codeine hydrochloride are obtained. The dish is dried to constant weight in the water oven and weighed, and the residue taken as $C_{18}H_{21}NO_3HCl + 1\frac{1}{2}H_2O$.

The method has been tested with pure codeine and on opium, with and without added amounts of codeine.

We would refer here to a surprising criticism of our method which has been made by Rakshit (*Analyst*, 1921, 46, 485). He states that the shaking of the opium extract with toluene gives rise to an emulsion which cannot be broken. We need only reply that we always recover 144 to 145 cc. of the 150 cc. of toluene actually used for the extraction, and have had no trouble at all with emulsion formation in the many hundreds of codeine estimations we have made. Five assistants have worked the method with success. If the opium extract be vigorously shaken up with toluene, then of course one gets great difficulty owing to emulsion formation, but one naturally assumes that ordinary manipulative skill will be exercised.

Experiments With Pure Codeine.—Three portions of 0.2992, 0.1995 and 0.0997 grm. respectively of pure anhydrous codeine were analysed as in the above method, and the following results obtained:

Anhydrous Codeine Taken Grm.	Codeine Hydochloride Corresponding With Half the Codeine Taken.* Actual Yield Grm.	Theoretical Yield Grm.	Codeine Recovered Per Cent.
0.2992	0.1738	0.1809	95.96
0.1995	0.1148	0.1206	95.10
0.0997	0.0580	0.0603	96.16

*Note.—Eighty cc. of water and 2 grms. of lime were triturated with the codeine, and 50 cc., or $\frac{5}{8}$ of this, taken for analysis. Four-fifths of this were used in the final operation. Hence the codeine hydrochloride finally obtained corresponds with $\frac{4}{5} \times \frac{5}{8}$ or half of the codeine taken.

Hence the method accounted for 95 to 96 per cent. of the codeine taken. Many other experiments have been carried out on similar lines, and a recovery of 94 to 96 per cent. is always obtained.

Experiments With Opium, With and Without Known Added Amounts of Codeine.—A sample of opium well powdered in a mortar, and five portions, numbered 1, 2, 3, 4 and 5, each of 8 grms. were then taken. To portions numbered 3, 4 and 5, quantities of 0.0994, 0.0497 and 0.0248 grm. of pure anhydrous codeine were added respectively. Portions 1 and 2 received no additions. All five portions were then analysed by our method, with the following results:

			Codeine Hydrochloride.		Codeine in Opium.	
				Theoretical Yield on Basis of Average Analyses		Theory Based on Average Result for
Sample No.	Opium Taken Grm.	Anhydrous Codeine Added Grm.	Actual Yield Grm.	of Samples 1 and 2 Grm.	Found Per Cent.	Samples 1 and 2 Per Cent.
1.	8.00	nil	0.1284	0.1305	2.65	2.69
2.	8.00	nil	0.1326		2.74	
3.	8.00	0.0994	0.1856	0.1910	3.83	3.94
4.	8.00	0.0497	0.1544	0.1607	3.19	3.32
5.	8.00	0.0248	0.1398	0.1456	2.89	3.01

Several other similar series were carried out and the results were just as satisfactory.

Purity of the Product.—The codeine hydrochloride recovered by us is practically colourless and crystallises in beautiful rosettes of needles. These are indications of its purity. We have, however, examined the product polarimetrically, as follows: We took the following samples of codeine hydrochloride for examination:

(1) 0.2524 grm. recovered from analyses of opiums; (2) 0.2942 grm. recovered from analyses of opiums containing added amounts of codeine; (3) 0.4000 grm. recovered from the analysis of pure codeine.

The substance in each case was dissolved in 50 cc. of water, and the solution filtered and read in a 200 mm. tube in a Hilger saccharimeter with the use of white light. The readings obtained were —3.31, —3.70 and —5.04 respectively, each figure being an average of ten closely agreeing readings. Assuming the codeine hydrochloride in 3 to be pure, the readings for 1 and 2 should theoretically have been —3.18 and —3.71 respectively. Our product would therefore appear to be of a satisfactory degree of purity.

CONCLUSIONS.—The method we have devised for codeine estimation gives satisfactory results and recovers approximately 95 per cent. of the codeine present in opium. The modification here described has been in continual use in this laboratory during the past year, and has proved itself trustworthy in practice.

THE TEACHING OF SCIENCE.*†

The prime claim of science to a place in the school curriculum is based upon the intellectual value of the subject matter and its application to life. This conception of education through science as the best preparation for complete living was Herbert Spencer's contribution to educational theory; and to its influence the introduction of science into the school is largely due. Spencer's doctrine was in accord with the principles of Pestalozzi as to the sequence in which facts and ideas should be presented and be related to stages of development, in order to be effective in creating or fostering natural interests in the mind of the child. Scientific instruction implies, therefore, not alone knowledge that is best for use in life, but knowledge adapted to the normal course of mental development. Both substance and method should be judged by the criterion of what is of greatest immediate worth or nearest to the pupil's interest at the moment. When this standard of psychological suitability is applied to the school science courses now usually followed, it must be confessed that they rarely reach it, many topics and much material being remote from the pupil's natural interests and needs.

The truth is that in the design of science courses for schools "trial-and-error" methods have been followed. In the absence of accurate knowledge these are the only possible methods of construction, but sufficient is now known of child psychology to produce a scheme of scientific instruction which represents not merely the views of advocates of particular subjects, but is biologically sound because it is in accord with the principles of mental growth, and, therefore, with those of educational science. When instruction in science

*Reprinted from *Science*.

†From the address of the president of the section of Educational Science, British Association for the Advancement of Science, Hull, September, 1922.

was first introduced into schools its character was determined by insight and conviction rather than by mental needs or interests; so later, when practical work came to be regarded as an essential part of such instruction, its nature and scope represented what certain authorities believed pupils should do, instead of what they were capable of doing with intelligence and purpose. Practical chemistry became drill in the test-tubing operations of qualitative analysis, and the result was so unsatisfactory from the points of view of both science and education that when Professor Armstrong put forward a scheme of instruction devised by him, in which intelligent experimentation took the place of routine exercises, acknowledgment of its superior educational value could not be withheld, and for thirty years its principles have influenced the greater part of the science teaching in our schools.

In its aims the "heuristic" methods of studying science energetically advocated by Professor Armstrong were much the same as those associated with the names of other educational reformers. Education in every age tends to a condition of scholasticism, and practical science teaching is no exception to this general rule, its trend being towards ritual, after which a revolt follows in the natural order of events. Comenius, with his insistence upon sense perception as the foundation of early training—"Leave nothing," he said, "until it has been impressed by means of the ear, the eye, the tongue, the hand"; John Dury among the Commonwealth writers who urged that pupils should be guided to observe all things and reflect upon them; Locke, with his use of sciences not to bring about "a variety and stock of knowledge, but a variety and freedom of thinking"; and Rousseau, who would "measure, reason, weigh, compare," not in order to teach particular sciences, but to develop methods of learning them—all these were in different degrees apostles of the same gospel of education according to Nature, and the development of a scientific habit of mind as the intention of instruction. What Rousseau persistently urged in this direction was clearly formulated by Spencer in the words, "Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible"—principles which cover all that is implied in what has since been termed "heuristic" teaching.

Professor Armstrong's particular contribution to educational science consisted in the production of detailed schemes of work in

which these principles were put into practice. Ideas are relatively cheap, and it needs a master mind to make a coherent story or useful structure from them. This was done in the courses in chemistry outlined in reports presented to the British Association in 1889 and 1890, and the effect was a complete change in the methods of teaching that subject. "The great mistake," said Professor Armstrong, "that has been made hitherto is that of attempting to teach the elements of this or that special branch of science; what we should seek to do is to impart the elements of scientific method and inculcate wisdom, so choosing the material studied as to develop an intelligent appreciation of what is going on in the world." One feature of heuristic instruction emphasized by its modern advocate, but often neglected, is that which it presents to the teaching of English. Accounts of experiments had to be written out in literary form describing the purpose of the inquiry and the bearing of the results upon the questions raised, and wide reading of original works was encouraged. A few years ago English composition was regarded as a thing apart from written work in science, but this should not be so, and most teachers would now agree with the view expressed by Sir J. J. Thompson's committee on the position of natural science in the educational system of Great Britain that "All through the science course the greatest care should be taken to insist on the accurate use of the English language, and the longer the time given to science the greater becomes the responsibility of the teacher in this matter. . . . The conventional jargon of laboratories, which is far too common in much that is written on pure and applied sciences, is quite out of place in schools."

When heuristic methods are followed in the spirit in which they were conceived, namely, that of arousing interest in common occurrences, and leading pupils to follow clues as to their cause, as a detective unravels a mystery, there is no doubt as to their success. No one supposes that pupils must find out everything for themselves by practical inquiry, but they can be trained to bring intelligent thought upon simple facts and phenomena, and to devise experiments to test their own explanations of what they themselves have observed. It is impossible, however, to be true to heuristic methods in the teaching of science and at the same time pay addresses to a syllabus. A single question raised by a pupil may take a term or a year to arrive at a reasonable answer, and the time may be well spent in forming habits

of independent thinking about evidence obtained at first hand, but the work cannot also embrace a prescribed range of scientific topics. Yet under existing conditions, in which examinations are used to test attainments, this double duty has to be attempted by even the most enlightened and progressive teachers of school science. There can, indeed, be no profitable training in research methods in school laboratories under the shadow of examination syllabuses. Where there is freedom from such restraint, and individual pupils can be permitted to proceed at their own speeds in inquiries initiated on their own motives, success is assured, but in few schools are such conditions practicable; so that, in the main, strict adherence to the heuristic method is a policy of perfection which may be aimed at but is rarely reached.

A necessary condition of the research method of teaching science is that the pupils themselves must consider the problems presented to them as worth solving, and not merely laboratory exercises. Moreover, the inquiries undertaken must be such as can lead to clear conclusions when the experimental work is accurately performed. It may be doubted whether the rusting of iron or the study of germination of beans and the growth of seedlings fulfills the first of these conditions, and the common adoption of these subjects of inquiry is due to custom and convenience rather than to recognition of what most pupils consider to be worth their efforts. It needed a Priestley and a Lavoisier to proceed from the rusting of iron to the composition of air and water, and even such an acute investigator as Galileo, though well aware that air has weight, did not understand how this fact explained the working of the common suction pump. If research methods are to be followed faithfully, and what pupils want to discover about natural facts and phenomena is to determine what they do, then teachers must be prepared to guide them in scores of inquiries both in and out of the laboratory. Under the exigencies of school work it is impracticable to contemplate such procedure, and all that can be usefully attempted is to lead pupils to read the book of Nature and to understand how difficult it is to obtain a precise answer to what may seem the simplest question.

The mission of school science should not, indeed, be only to provide training in scientific method—valuable as this is to every one. Such training does cultivate painstaking and observant habits, and encourages independent and intelligent reasoning, but it cannot be held in these days that any one subject may be used for the general

nourishment of faculties which are thereby rendered more capable of assimilating other subjects. Modern psychology, as well as everyday experience, has disposed of this belief. If the doctrine of transfer of power were psychologically sound, then as good a case could be made out for the classical languages as for science, because they also may be taught so as to develop the power of solving problems and of acquiring knowledge at the same time. When, therefore, advocates of particular courses of instruction state that they do not pretend to teach science, but are concerned solely with method, they show unwise indifference to what is known about educational values. Locke's disciplinary theory—that the process of learning trains faculties for use in any fields, and that the nature of the subject is of little consequence—can no longer be entertained. It has now to be acknowledged that information obtained in the years of school life is as important as the process of obtaining it; that, in other words, subject matter as well as the doctrine of formal discipline must be taken into consideration in designing courses of scientific instruction which will conform to the best educational principles.

So long ago as 1867 the distinction between subject and method was clearly stated by a Committee of the British Association, which included among its members Professor Huxley, Professor Tyndall and Canon Wilson. It was pointed out that general literary acquaintance with scientific things in actual life and knowledge relating to common facts and phenomena of nature were as desirable as the habits of mind aimed at in scientific training through "experimental physics, elementary chemistry and botany." The subjects which the committee recommended for scientific information, as distinguished from training, comprehended "a general description of the solar system; of the form and physical geography of the earth, and such natural phenomena as tides, currents, winds and the causes that influence climate; of the broad facts of geology; of elementary natural history with especial reference to the useful plants and animals; and of the rudiments of physiology." If we add to this outline a few suitable topics illustrating applications of science to everyday life, we have a course of instruction much more suitable for all pupils as a part of their general education than what is now commonly followed in secondary schools. It will be a course which will excite wonder and stimulate the imagination, will promote active interest in the beauty and order of nature, and the extension of the kingdom of man, and provide guidance in the laws of healthy life.

The purpose of this kind of instruction is, of course, altogether different from that of practical experiment in the laboratory. One of the functions is to provide pupils with a knowledge of the nature of everyday phenomena and applications of science, and of the meaning of scientific words in common use. Instead of aiming at creating appreciation of scientific method by an intensive study of a narrow field, a wide range of subjects should be presented in order to give extensive views which cannot possibly be obtained through experimental work alone. The object is indeed almost as much literary as scientific, and the early lessons necessary for its attainment ought to be within the capacity of every qualified teacher of English. Without acquaintance with the common vocabulary of natural science a large and increasing body of current literature is unintelligible, and there are classical scientific works which are just as worthy of study in both style and substance as many of the English texts prescribed for use in schools. We all now accept the view that science students should be taught to express themselves in good English, but little is heard of the equal necessity for students of the English language to possess even an elementary knowledge of the ideas and terminology of everyday science, which are vital elements in the modern world, and which it is the business of literature to present and interpret.

So much has been, and can be, said in favor of broad courses of general informative science in addition to laboratory instruction and lessons which follow closely upon it, that the rarity of such courses in our secondary schools is a little surprising at first sight. Their absence seems to be due to several reasons. In the first place, the teachers themselves are specialists in physics, chemistry, biology or some other department of science, and they occupy their own territory in school as definitely as Mr. Eliot Howard has shown to be the behavior-routine of birds in woods and fields. You may, therefore, have a teacher of physics who has taken an honors degree and yet knows less of plant or animal life than a child in an elementary school where nature study is wisely taught; and, on the other hand, there are teachers of natural history altogether unacquainted with the influence of physical and chemical conditions upon the observations they describe or the conclusions they reach. Natural science as a single subject no longer exists either in school or university, and with its division and subdivision has come a corresponding limitation of interest.

No man can now be considered as having received a liberal education if he knows nothing of the scientific thought around him, but it is equally true that no man of science is scientifically educated unless his range of intellectual vision embraces the outstanding facts and principles of all the main branches of natural knowledge. It cannot reasonably be suggested that this general knowledge of science should be acquired by all if teachers of science themselves do not possess it. During the past thirty years or so there has been far too much boundary-marking of science teaching in school on account of the specialized qualifications of the teachers. What is wanted is less attention to the conventional division of science into separate compartments designed by examining bodies, and more to the whole field of nature and the scientific activities by which man has transformed the world; and no teacher of school science should be unwilling or unqualified to impart such instruction to his pupils.

Where such teachers do exist, however, they are compelled by the exigencies of examinations to conform to syllabuses of which the boundary lines are no more natural than those which mark political divisions of countries on a map of the world. All that can be said in favor of the delimination of territory is that it is convenient; the examiner knows what the scope of his questions may be, and teachers the limits of the field they are expected to survey with their pupils. While, therefore, it may be believed that a general course of science is best suited to the needs of pupils up to the age of about sixteen years, examining authorities recognize no course of this character, and very few schools include it in the curriculum. Expressed in other words, the proximate or ultimate end of the instruction is not education but examination, not the revealing of wide prospects because of the stimulus and interest to be derived from them, but the study of an arbitrary group of topics prescribed because knowledge of them can be readily tested. It may be urged that this is the only practicable plan to adopt if a science course is to have a defined shape, and not, like much that passes for nature study, merely odds and ends about nature, without articulation or purpose. Acceptance of this view, however, carries with it the acknowledgment that expediency rather than principle has to determine the scope and character of school science, which is equivalent to saying that science has no secure place in educational theory. I prefer to believe that a school course of general science can be constructed which is largely informative and at the same time truly edu-

cational, but it must provide what is best adapted to enlarge the outlook and develop the capacity of the minds which receive it, and not be determined by the facilities it offers for examinational tests.

A third reason for the relative absence of general scientific education in schools is the demands which the teaching might make upon apparatus and equipment. Simple quantitative work in physics, chemistry or botany can be done in the laboratory with little apparatus, and a single experiment may occupy a pupil for several teaching periods. To attempt to provide the means by which all pupils can observe for themselves a wide range of unrelated facts and phenomena belonging to the biological as well as to the physical sciences is obviously impracticable, and would be educationally ineffective. Experiments carried out in the laboratory should chiefly serve to train and test capacity of attacking problems and arriving at precise results just as definitely as do exercises in mathematical teaching. But knowledge by itself, whether of quantitative or qualitative character, is not sufficient, and it becomes power only when it is expressed or used. Every observation or experiment carries with it, therefore, the duty of recording it clearly and fully in words or computations, or both, and if this is faithfully done laboratory work of any kind may be made an aid to English composition as well as an incentive to independent inquiry and intelligent thought.

It is very difficult, however, to devise a laboratory course of general science which shall be both coherent and educative; shall be, in other words, both extensive in scope and intensive in method. I doubt, indeed, whether any practical course can perform this double function successfully. Probably the best working plan is to keep the descriptive lessons and the experimental problems separate, using demonstrations in the classroom as illustrations, and leaving the laboratory work to itself as a means of training in scientific method or of giving a practical acquaintance with a selected series of facts and principles. The main thing to avoid is the limitation of the science teaching to what can be done practically; for no general survey is possible under such conditions. Even if two-thirds of the time available for scientific instruction be devoted to laboratory experiment and questions provoked by it, the remaining third should be used to reveal the wonder and the power and the poetry of scientific work and thought; to be an introduction to the rainbow-tinted world of nature as well as provide notes and a vocabulary which will make classical

and contemporary scientific literature intelligible. If there must be a test of attention and understanding in connection with such descriptive lessons, because of the spirit of indifference inherent in many minds—young as well as old—let it be such as will show comprehension of the main facts and ideas presented and knowledge of the meaning of the words and terms used. In this way descriptive lessons may be used to provide material for work and active thought, and light dalliance with scientific subjects avoided.

It may be urged that no knowledge of this kind has any scientific reality unless it is derived from first-hand experience, and this is no doubt right in one sense; yet it is well to remember that science, like art, is long while school life is short, and that though practical familiarity with scientific things must be limited, much pleasure and profit can be derived from becoming acquainted with what others have seen or thought. It is true that we learn from personal experience, but a wise man learns also from the experience of others, and one purpose of a descriptive science course should be to cultivate this capacity of understanding what others have described. As in art, or in music, or in literature, the intention of school teaching should be mainly to promote appreciation of what is best in them rather than to train artists, musicians or men of letters, so in science the most appropriate instruction for a class as an entity must be that which expands the vision and creates a spirit of reverence for nature and power of man, and not that which aims solely at training scientific investigators. It should conform with Kant's view that the ultimate ideal of education is nothing less than the perfection of human nature, and not merely a goal to be obtained by the select few.

The sum and substance of this address is a plea for the expansion of scientific instruction in this humanizing spirit, for widening the gateway into the land of promise where the destinies of the human orace are shaped. It is the privilege of a president to be to some extent pontifical—to express opinions which in other circumstances would demand qualification—and to leave others to determine how far the doctrines pronounced can be put into practice in daily life. I do not, therefore, attempt to suggest the outlines of courses of science teaching for pupils of different ages, or for schools of different types; this has been done already in a number of books and reports, among the latter being the report of Sir J. J. Thompson's committee on the position of natural science, the report of the British Association

committee on science teaching in secondary schools, Mr. O. H. Latter's report to the Board of Education on science teaching in public schools, the "science for all" report and syllabus issued by the Science Masters' Association, a Board of Education report on "Some Experiments in the teaching of Science and Hand-Work in Certain Elementary Schools in London," and one prepared for the board by Mr. J. Dover Wilson on "Humanism in the Continuation School." What has been said in this address as to the need for extending the outlook of customary scientific instruction beyond the narrow range of manual exercises, manipulative dexterity, experimental ritual or incipient research, can be both amplified and justified from these reports. I want science not only to be a means of stimulating real and careful thinking through doing things, but also a means of creating interest and enlarging the working vocabulary of the pupils and thus truly increasing their range of intelligence. So may scientific instruction be made a power and an inspiration by giving, in the words of the Book of Wisdom (vii: 16-20):

an unerring knowledge of the things that are,
To know the constitution of the world and the operation of the elements;
The beginning and end and middle of times,
The alternations of the solstices and the changes of seasons,
The circuits of years and the positions of stars;
The nature of living creatures and the raging of wild beasts,
The violences of wind and the thoughts of men,
The diversities of plants and the virtues of roots.

When school science has this outlook it will lie closer to the human heart than it does at present, and a common bond of sympathy will be formed between all who are guiding the growth of young minds for both beauty and strength. So will the community of educational aims be established and the place of science in modern life be understood by a generation which will be entrusted with the task of making a new heaven and a new earth. If these trustees for the future learn to know science in spirit as well as in truth we may look forward with happy confidence to the social structure they will build, in which knowledge will be the bedrock of springs of action and wisdom will make man the worthy monarch of the world.

RICHARD GREGORY.

SCIENTIFIC AND TECHNICAL ABSTRACTS

A NEW ARSPHENAMIN DERIVATIVE.—The arsenical benzene derivative introduced under the title "606" found rapid and satisfactory application in the treatment of widespread and serious disease. Difficulties in its administration led to further research and a derivative termed "neoarsphenamin" has come into general use, on account of the simplicity of the method of administration and the greater factor of safety. It is, however, a substance of somewhat uncertain composition and its solutions are unstable, even moderate shaking with air at ordinary temperature will accelerate decomposition very much. The parasiticidal powers of different batches show wide variation. A recent bulletin of the United States Public Health Service, describes a new compound "sulpharsphenamin," which is claimed to present advantages. The manufacture was carried out and the bulletin prepared by the joint work of Carl Voegtlin, J. M. Johnson and Helen Dyer. The procedure is by action of formaldehyde upon arsphenamin hydrochloride followed by sodium bisulphite. The exact method is set forth. The product is a yellowish powder, which does not change in appearance in dry air after several days' exposure, and dissolves with ease in water, forming a colored solution. The pH of twenty different batches ranged from 3.2 to 4.6. A 10 per cent. solution is considerably hypotonic to blood. The drug gives most of the qualitative tests for neoarsphenamin, but may be distinguished from it by not decolorizing indigo-carmine. The average arsenic content of the new substance is 22 per cent.—H. L.

DETERMINATION OF FORMALDEHYDE.—This problem has engaged the attention of many chemists. The processes suggested are numerous and of several distinct types. The employment of the substance as a food preservative has been extensive, and legislation against such has been generally established. Raoul Gros has recently reviewed much of the literature relating to methods of determination. The fact that methyl alcohol is comparatively easily con-

verted into formaldehyde, has given added importance to the detection and determination of the latter, owing the frequent use of the alcohol as a substitute and adulterant for ethyl alcohol. As a result of the investigation of many quantitative procedures for formaldehyde, Gros was led to devise a new one, which is described in *J. Pharm. Chim.* [7], 1922, v. 24, 415. It depends on oxidation by potassium mercuric iodide in strongly alkaline solution. The solutions are:

A	Mercuric chloride	13.55 grams
	Potassium iodide	36.00 "
	Water to make	500.00 cc.
B	Pure sodium hydroxide	129.00 grams
	Water to make	500.00 cc.

The formaldehyde solution should be diluted so as to contain not appreciably more than 1 gram per 100 cc. Five cc. of this solution are mixed with 35 cc. of the mercury solution in a conical flask and then by means of a slender tube 20 cc. of the alkali are added with shaking. The flask is closed and again well shaken during five minutes. A brick-red precipitate appears, which gradually changes to a dark gray. The reaction is usually complete in ten minutes, but it is advisable to allow about five minutes more. All odor of the formaldehyde should have disappeared. Hydrochloric acid diluted with an equal volume of water is then added to slight acidity. The amount of acid needed should be previously determined. The quantity will be about 20 cc. After mixing the acid, 20 cc. of N/10 iodine solution are added and the liquid shaken until all the mercurial precipitate is dissolved. The complete solution of this precipitate is essential. The excess of iodine is determined by titration with sodium thiosulphate. If Q represents the amount of the aldehyde in the solution, and n the cc. of thiosulphate required, the calculation can be made by the formula: $Q = 3(20-n)$.

Gros has investigated the process devised by Bouchet and Cambier published in *C. r.* 1895, v. 120, 449, depending on the fact that when formaldehyde is mixed with hydroxylamine hydrochloride, the amine unites with the aldehyde and sets free an equivalent quantity of hydrochloric acid which can be titrated in the ordinary manner, methyl orange being advised as an indicator. Gros found that the

point of color change was not exact, due to the presence of ammonium salts. As hydroxylamine salts act promptly on Nessler solution this reagent is not available, unless the hydroxylamine is destroyed, which is accomplished by adding a solution of iodine to the solution of the sample containing also sodium acetate and potassium carbonate. The latter saturates the hydriodic acid formed. The excess of iodine is removed by addition of sodium thiosulphate.

The method of determining the ammonium in samples of hydroxylamine hydrochloride is given in detail with a figure of the apparatus. A commercial sample marked pure was found to yield more than 10 per cent. of ammonia (NH_3) corresponding to over 30 per cent. of ammonium chloride. It is obvious, therefore, that in employing hydroxylamine hydrochloride for analytic purposes its purity should be assured. Pure material prepared by Gros gave no reaction for ammonia by his method and he found that this material gave good results in determining formaldehyde by the method of Bouchet and Cambier.—H. L.

Food Requirements of Man.—The Food (War) Committee of the Royal Society has published a Report on the Food Requirements of Man and Their Variations According to Age, Sex, Size and Occupation. On account of refuse and waste, the food as purchased should contain approximately 10 per cent. more utilizable calories than are actually required by the individual. The energy requirement of a man varies with the work performed, and ranges from 2500 to 5000 calories daily; it may rise as high as 6000 or even 8000 calories daily in exceptional cases such as the Canadian lumbermen in winter. The average working woman requires 2400 calories of energy daily; women engaged in sedentary labor such as typewriting require only 1900 calories daily. Brain workers require from 2200 to 2600 calories daily; their diet should be relatively high in protein. During exposure to low temperatures, extra energy should be supplied as protein (meat or fish) to those engaged in sedentary occupations, and as fat to those engaged in bodily work. Children under 6 years of age have 50 per cent. of the food requirement of an average man, those between 6 and 10 years 60 per cent., and those between 10 and

13 years 83 per cent. of that requirement; those over 13 years of age require the same amount of food as an adult of the same sex. A growing child working with the same energy as an adult man requires approximately 200 additional calories daily.

The diet of an average man should contain at least 70 or 80 grams of protein daily, a portion of which should be of animal origin. Milk should serve as a source of protein in the diet of infants and young children. The minimum amount of fat required daily varies with the race, from 20 grams in the case of a Japanese soldier to 75 grams in the case of people of British descent. From 35 to 40 per cent. of the total energy requirement of the body may be supplied as fat; those engaged in vigorous muscular work should receive at least 25 per cent. of their energy intake in the form of fat. A certain amount of fresh fruits or green vegetables should be eaten to supply the requisite vitamines. The diet should also include carbohydrates and salts.

A condition of semi-starvation, with the food intake reduced to two-thirds its normal value, apparently can be endured for a period of several months without danger to health, but gives rise to a greatly reduced resistance to tuberculosis if extended over a period of several years.—J. S. H.

MEDICAL AND PHARMACEUTICAL NOTES

A SUGAR-BEARING FLOWER.—Saccharine fluids are common in flowers, but the amounts are generally quite minute, suitable only for gathering by insects. In certain districts in India, however, a tree produces flowers in which the corolla contains sufficient sugar to constitute a source of supply to those living in the region. The plant is a member of the Sapotaceæ, classified as *Bassia latifolia* Roxb. by some authorities, but by Engler and Prantl as *Illipe latifolia* Engler. The tree attaining a height of about twenty meters and two meters in circumference, is widely distributed in Central India. The use of the

corollas as a source of sugar dates from a remote period. The native name "Mahwa" or "Mahuca" is said to be derived from a Sanskrit word meaning "sweet."

A lengthy account of the plant and its chemical constituents is given by Lendner in *Schweizerische Apotheker-Zeitung* (1922, 60th year, 713) from which the above statements and those that follow have been taken. The tree flowers in March and April, and ripens seed in July and August. After a time the corollas swell, gradually lose their attachment to the calyx and finally fall to the ground, where they are gathered by the inhabitants. At night the locality is visited by many wild animals. Cows eat the flowers voraciously and give a milk strongly flavored by the accessory substances present. The chemical composition of the flowers has been studied by a number of persons. The corollas are said to contain about 50 per cent. of crystallized invert sugar, with some tartaric and citric acids. The leaves contain traces of an alkaloid and a saponin. The seeds are rich in a fixed oil. The specimens that Lendner examined did not contain nearly the proportion of sugar stated by some other authorities, as he found only 5.16 per cent. The samples were not very sweet. As might be expected, the sugar content of the corollas has led to the preparation of an intoxicating beverage by the inhabitants. The distilled product has a disagreeable taste and high intoxicating powers. Notwithstanding the taste it is stated that British soldiers in India drink it to excess and much of the mortality of these soldiers is attributed to this practice. The religion of the natives forbids the use of alcohol, but a large number of distilleries are operating in the region. Investigation has shown that the plant carries a special yeast hitherto undescribed.—H. L.

VACCINATION IS TWO THOUSAND YEARS OLD.—"Vaccination is an outgrowth of man's effort to protect himself from pestilence by using nature's methods of defense," says Dr. G. W. McCoy, director of the Hygienic Laboratory of the United States Public Health Service. "Primitive man noticed that recovery from a first attack by most diseases gave immunity against other attacks; and some 2000 years ago he began to inoculate his fellows with smallpox when conditions seemed propitious instead of waiting for nature to do it at some time when conditions might be very unpropitious.

"Inoculations against smallpox were made in India and in China as early as 300 B. C. Later, when the disease reached Europe, inoculation went with it, supplemented by a new method called 'selling small-pox'—exposing a well person to contact with one ill with the disease so that if he survived he would be proof against it.

"Inoculation differs somewhat from vaccination as devised by Jenner, but the principle is the same. Moreover, long before Jenner's day it was known that an attack of cowpox gave immunity from smallpox; and records show that men who had recovered from cowpox had themselves inoculated with smallpox to make the proof conclusive. Jenner, however, as he himself says, 'placed vaccination on a rock,' where he knew it would be immovable.

"Before the days of vaccination conservative estimates show that one-third of all persons had smallpox and one-tenth of all deaths were due to it. Today smallpox is rare; many physicians have never seen a case; and, where vaccination is consistently practiced no deaths from it occur. Formerly smallpox was considered a children's disease; and it still is a child's disease—where infantile and school vaccination is neglected. Witness the Philippines, where four or five years ago, after years of neglect of vaccination, an epidemic swept away nearly 50,000 persons, a large percentage of whom were children under ten years of age.

"In the United States, well-vaccinated communities show low smallpox rates—Maryland with one-tenth case per thousand population; New York with one-fortieth per thousand, and the District of Columbia with 0.14 per thousand. Poorly vaccinated States tell another story: Oregon with 1.45; Washington with 1.72, and Kansas with 2.0 per thousand population.

"Some communities wait till an epidemic breaks out and then rush to vaccinate. These stop the disease—after it has caused many deaths and has 'branded' many survivors. Sixteen months ago, in Kansas City, an epidemic of smallpox began, yielding 350 cases and 123 deaths; and a few months later another started in Denver and yielded 950 cases and 288 deaths. Such epidemics always end the opposition to vaccination in the community—for a time."

BOOK REVIEWS

INDUSTRIAL ORGANIC CHEMISTRY. By Dr. Samuel P. Sadtler and Dr. Louis J. Matos. Fifth Edition. J. B. Lippincott Company, Philadelphia and London. Price, $8.

The first edition of this work appeared in 1891, when there was no other American textbook dealing with the chemical phases of the developing industries of this country. The writer recalls vividly his own impressions of that volume, which, at the time, supplied a real need, and accordingly received a warm welcome.

That it was a solid book, full of information, appeared on inspection. But with use came a growing recognition of the dependableness of this work, and the editions which have appeared since then have been characterized by that same quality—dependableness.

The edition which is now before us—the fifth—followed its predecessor after an interval of eleven years—years which mark the greatest activity and advancement in the history of the chemical industries. The book had to be rewritten almost in its entirety, and this has been done with fidelity and care by the authors who, fortunately, have had unusual opportunities to secure information at first hand.

Since the advent of the fourth edition, in 1912, there have been epoch-making discoveries, and many changes in factory methods for mass production. The growing automobile industries and the improvement and extended use of internal combustion engines have revolutionized petroleum distillation; the cracking process has been adapted to the production of a higher yield of gasoline, and we have learned to procure gasoline also from natural gas. We have entered upon an era of road-building, and asphalt and pitch from coal tar for surfacing have presented new problems of great economic importance. Hydrogenated oils have taken a permanent place as edible fats. "Blown oils," vulcanized oils, and artificial rubber, have come into extensive use. The development of the flotation method for the separation of sulphide ores has created new markets for pine oils.

New starch products have become common commodities. The fermentation industries have experienced many radical changes, and new bio-chemical methods of manufacture have come into vogue. Powdered milk and other new milk products have secured a place in our markets, largely because of improvements in their manufacture. The cellulose industries have developed marvelously, artificial silk, artificial leather, and the cellulose plastics, being manufactured on a great scale. The by-product coke oven has largely replaced the primitive coke oven, which produced only coke, and wasted the valuable ammonia and coal tar. The manufacture of synthetic dyes is rapidly becoming an important American industry.

Truly, these eleven years have meant much to the chemical industries, and the advances made have been faithfully recorded in the new edition, in which the subject matter is presented under the following captions:

The Industries of Mineral Oils and Allied Bitumens, Fats and Fatty Oils, Essential Oils and Resins, Sugar, Starch and Its Alteration Products, Fermentation Products, Milk, Cellulose, Vegetable Textile Fibres, Textile Fibres of Animal Origin, Animal Tissues and Their Products, Wood Products, Coal Tar, Coal Tar Dyes, Natural Coloring Matters, Bleaching, Dyeing and Textile Products.

The initial plan of the book has not been changed. Industrial production and factory methods are set forth with adequate detail; raw materials are discussed at some length; commercial grades are described; analytical tests and methods for the examination of the products, constitute a prominent feature of the book, and give it a special value to control and "works" chemists. It is, however, no mere laboratory handbook, but a well-written and systematically arranged textbook for advanced students in chemistry,—a reliable reference work for the practical chemist, and the pharmacist.

It is a book which should meet with a wide sale, and we most heartily recommend it to the readers of this Journal.

J. W. S.

ORGANIC CHEMISTRY. Entirely new edition. By W. H. Perkin, Ph. D., Sc. D., LL. D., F. R. S., Professor of Chemistry, Victoria University, Manchester, and F. Stanley Kipping, Ph. D., Sc. D., F. R. S., Professor of Chemistry, University College, Nottingham. W. & R. Chambers, Limited, London, and J. B. Lippincott Company, Philadelphia.

Owing to the continued progress of organic chemistry, a thorough revision of this widely used textbook has become necessary. The scope of the work has been enlarged, chiefly by the addition of matter which meets the requirements of medical students. The original aims and general plan of the book remain unaltered. The work consists of two books, called Part I and Part II.

Part I, in 333 pages, deals with the fatty compounds. It contains a general account of the methods most frequently employed in the separation, precipitation and analysis, including the determination of the molecular weight. The preparation and properties of typical compounds are described, attention being directed to those changes which come under the heading of general reactions, rather than to isolated facts regarding particular substances. Questions of constitution are also discussed at some length, and in the case of most of the typical compounds the facts on which the given constitutional formula is based are specifically mentioned. This course was adopted because, in the opinion of the authors, a constant use of constitutional formulæ, accompanied by a clear conception of their meaning, is one of the greatest helps, even to a beginner, in committing the facts to memory. The referee can fully subscribe to this!

Part II, in 330 pages, deals with the aromatic compounds from coal tar and benzene to the various dyes and their applications. Particular attention is given to questions of constitution, one of the objects being to train the student to think out such matters and to try to deduce a constitutional formula for a given substance, by comparing its properties with those of others of known constitution. With this end in view the most important evidence in favor of the accepted constitutional formula is often withheld until the subject has been discussed at some length.

One of the principal objects in this work has been to treat the subject from a practical standpoint, as far as can be done in a textbook on theoretical chemistry, because, unless a thorough course of

practical work accompanies the theoretical no real satisfactory progress can be made. It is for this reason in particular that we can also recommend the work to American students.

OTTO RAUBENHEIMER, Ph. M.

FORENSIC CHEMISTRY. By A. Lucas, O. B. E., F. I. C., Director, Government Analytical Laboratory and Assay Office, Cairo, Egypt; Fellow of the Chemical Society, member American Chemical Society, member Society Public Analysts, etc. Octavo, 268 pp. Cloth, $5.25. London, Edward Arnold & Co., and Longmans, Green & Co., New York.

Forensic or legal chemistry may be defined as chemistry applied to the solution of certain problems which arise in connection with the administration of justice. It is chemistry in the service of law. Forensic chemistry deals not only with purely chemical questions, such as the nature, composition and quality of materials as determined by analysis and the examination of articles for the presence or absence of particular substances, such as poisons, but it is concerned also with questions which are only partly chemical, as *f. i.*, the examination of blood stains, questioned documents, counterfeit coins, fibres and textiles. For that reason the expert in forensic chemistry should be not only a capable analyst, but also an experienced microscopist and photographer.

The practice of forensic chemistry resolves itself into three stages, namely, the reception of the article to be examined, the examination and the communication of the results. All three stages are carefully considered in the book before us, which contains twenty-one chapters, including Blood Stains, Clothing, Counterfeit Coins, Documents, Finger Prints, Poisons, Stains and Marks, Textile Fabrics, Tobacco, etc. Methods of examination and details of manipulation which are known to every analyst and which are found in the ordinary textbooks have been omitted, but special methods required by the expert are given in full. The chapter on Poisons is very complete, comprising 46 pages and including the extraction and testing of alkaloids. A very complete index concludes the work, which we can highly recommend.

OTTO RAUBENHEIMER, Ph. M.

TREATISE ON MATERIA MEDICA AND VEGETABLE CHEMISTRY. By Dr. L. Reutter, privat-docent at the University of Geneva. The work will make a quarto volume of about 850 pages of two columns, with 293 illustrations. It is placed on sale in 8 parts of about 112 pages. Price of each part, 12 francs. Parts I, II and III are now on sale, each 12 francs (add 10 per cent. for mailing). J. Baillière & Son, 19 Rue Hautefeuille, Paris VI.

This work is from the hand of a master; one is assured in turning over the pages of the scientific and scholarly manner in which the subject is handled. The type, though condensed, is clear and easily read, the page presenting a pleasing appearance. The many illustrations are excellent. Great pains have been taken by the author to enumerate and describe the various falsifications to which vegetable and animal drugs are subject. Much space is devoted to the chemistry of vegetable drugs—this feature of the work having been given particular attention and will prove to be of great value to students, teachers, pharmacists and physicians. Permit us to quote the opinion of Professor Ranwez, of Louvain, regarding Dr. Reutter's excellent work:

"The author of this work has greatly added to and developed the knowledge which we possess regarding the chemical properties of simple drugs and has given to this very important part of his work the amplitude required—that which is generally in default in works of this nature. The work of Dr. Reutter is the very latest authority—up-to-date. I felicitate the author upon the results of his labor."

W. H. G.

The well-known publisher, Georg Thieme, in Leipzig, has submitted the following books, which should also become better known on this side of the Atlantic, for review:

GRUNDRISS DER PHYSIOLOGIE. Von Prof. Carl Oppenheimer und Prof. Dr. Otto Weiss.

I. BIOCHEMIE. Von Prof. Carl Oppenheimer, Dr. phil. et med., München. 4 Aufl. Lex. 349 pp., 7 Illust.

Biochemistry, the chemistry of life, is treated in this volume by an expert. The book is divided into two parts.

1. The chemistry of the animal body—Acyclic and Cylic Compounds, Proteins, Ferments and Antigens.

2. Chemical Functions of the Organism—Composition of Foods, Metabolism, Absorption of Foods, Secretion and Excretion, Regulation of Functions and Nerves and Muscles. The chapters on the Chemistry of Blood, on page 275, and on Urine, page 302, are especially valuable and should be studied with profit by all those interested.

II. BIOPHYSIK. Von Prof. Dr. Otto Weiss, Director des physiolog. Instituts, Königsberg. 2 Aufl. Lex. 307 pp., 180 Illust. and a colored plate.

The older physiology assumed the presence of a mysterious "force of life" or "*sui generis*." Not until this erroneous conception was thrown overboard did real research in physiology begin. The volume before us is a masterwork on the physical aspects of the science which treats of the functions of living bodies and of the organs composing them. Besides the nine chapters of the book, a three-column index of nine pages is a great help for ready reference.

Both volumes, "Biochemistry" and "Biophysics," are written by well-known authorities and are real master works.

GESAMMELTE ABHANDLUNGEN. Band I. Abteilung I: Untersuchungen über Komplexe anorganische Säuren. Abteilung II: Untersuchungen über Sterische Hinderung. Von Dr. F. Kehrmann. Lex. 203 pp., 2 Illust. $1.70.

The author, professor at the University of Lausanne, has rendered a good service by the publication of a collection of his papers in book form. It is a credit to American chemistry that the author prefers and uses the term "complex inorganic acids" given by Wolcott Gibbs, a student of Robert Hare, rather than the new term, "heteropolyacids." The book is full of bibliographic references and is furnished with both an author's and subject index.

MIKROMETHODIK. QUANTITATIVE BESTIMMUNG DER HARN- UND BLUTBESTAND-TEILE IN KLEINEN MENGEN FUR KLINISCHE UND EXPERMENTELLE ZDECKE. Von Dr. Med. et Phil. Ludwig Pincussen, wissensch. Assistent Mediz. Universitats Klinik in Berlin. 116 pp.

The object of this little book is to prove that chemical analysis can be done equally as well when only small quantities of specimens are furnished. The book contains chapters on General Rules, Weighing and Measuring, Colorimetric Methods, Nephelometry and Micro-analysis of Urine and Blood. The nineteen illustrations are a distinct advantage and help to elucidate the text. An appendix describes the determination of hydrogen ion concentration with indicators according to L. Michaelis. The little book is a jewel for those interested.

OTTO RAUBENHEIMER, Ph. M.